

*Lessie  
Grad. Catalog  
93-94*

# The Graduate School

University of Rhode Island

B U L L E T I N  
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**G**raduate study at the University of Rhode Island was inaugurated in 1907 with Master of Science degrees in chemistry and engineering. The Master of Arts degree was first awarded in 1951, and in 1960 the University awarded its first Doctor of Philosophy degree. Graduate work for professional degrees was initiated in 1962, when the degree of Master of Public Administration was first awarded. Today, the master's degree is offered in 56 areas of study and the doctorate in 35 areas.



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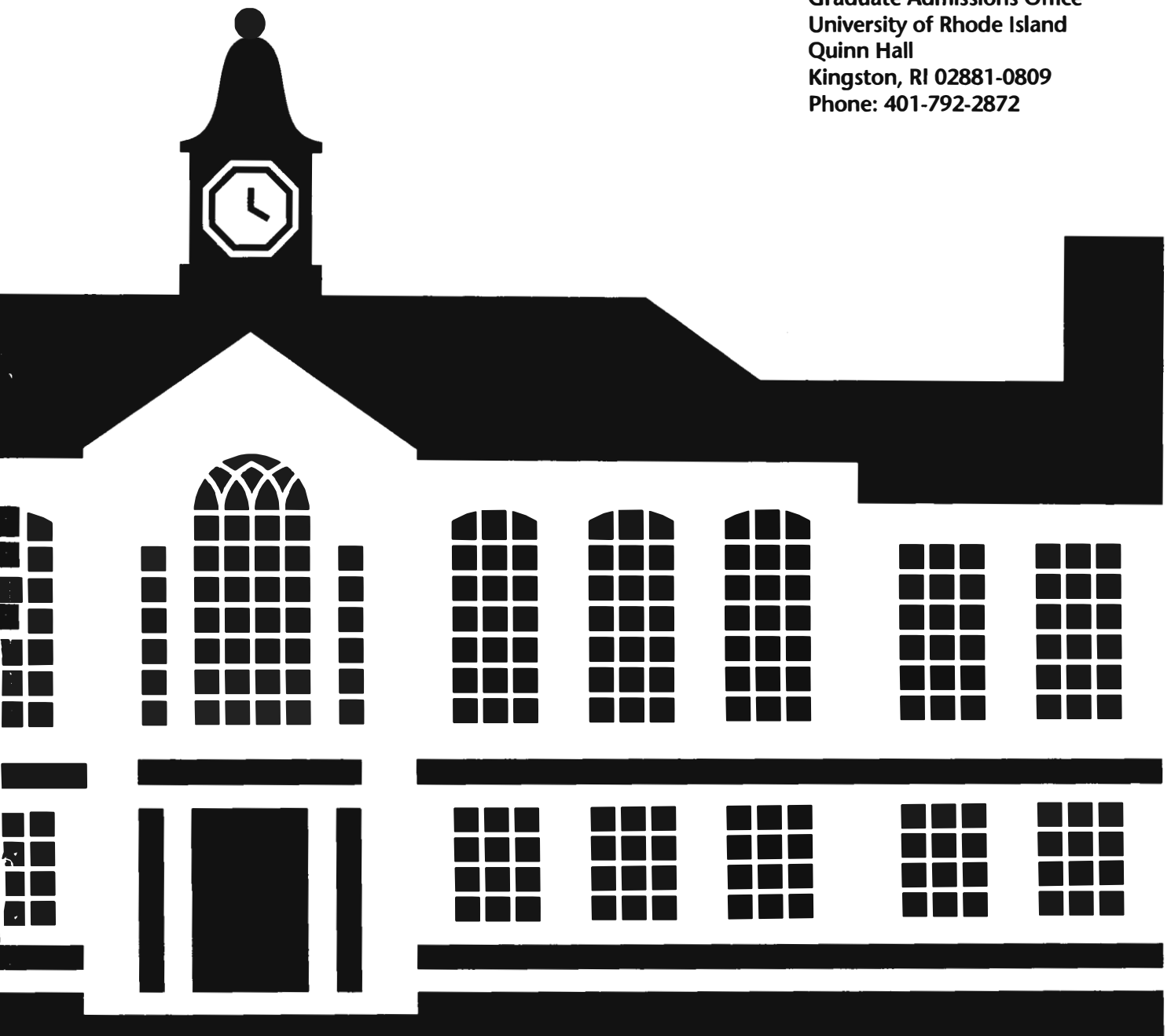
B U L L E T I N

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University of Rhode Island  
Quinn Hall  
Kingston, RI 02881-0809  
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# CALENDAR

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## Fall Semester 1993

**August 30–September 3**  
Registration week. Deadline for international students to arrive on campus.

**September 6, Monday**  
Holiday, Labor Day.

**September 8, Wednesday**  
Classes begin, Kingston Campus and College of Continuing Education (CCE). University Faculty meeting, 3:30 p.m.

**September 21, Tuesday**  
Final date to add courses, and for P-F option or audit requests. *Fees will not be adjusted downward for courses dropped after this date.*

**October 1, Friday**  
Final date for nominations for January graduation.

**October 11, Monday**  
Holiday, Columbus Day. Classes will not meet.

**October 12–15**  
Currently enrolled matriculating graduate students may pick up advance registration materials for spring 1994 from the Office of the Registrar.

**October 18–November 24**  
Currently enrolled matriculating graduate students may register for spring 1994 by telephone anytime after their earliest time to register.

**October 25, Monday**  
Midsemester. Final date to drop courses and to change from P-F option to grade.

**November 11, Thursday**  
Holiday, Veterans Day. Classes will not meet.

**November 15, Monday**  
Deadline for applications for spring 1994, except for programs with earlier deadlines.

**November 17, Wednesday**  
Thursday classes meet.

**November 25, Thursday**  
Thanksgiving recess begins, 8 a.m.

**November 29, Monday**  
Classes resume, 8 a.m.

**December 13, Monday**  
Programs of study due for students admitted for fall 1993. Classes end, Kingston Campus.

**December 14, 15**  
Reading days, Kingston Campus.

**December 16, Thursday**  
Final date for January candidates to submit completed master's and doctoral theses in a form acceptable for examination purposes along with the request for oral defense of theses. NO EXTENSIONS OF TIME WILL BE GRANTED. Theses must be submitted at least 20 calendar days prior to the date requested for oral defense. Selection of date should allow sufficient time for necessary revisions and retyping before submission in final form. See deadline below and note at the end of this calendar regarding scheduling examinations during the winter intersession.

**December 16–17, 20–23**  
Final examinations, Kingston Campus.

**December 18, Saturday**  
CCE classes and examinations end.

**December 28, Tuesday**  
Final grades due in the Office of the Registrar by 4 p.m.

## Spring Semester 1994

**January 10–14**  
Registration week.

**January 17, Monday**  
Holiday, Martin Luther King. Classes will not meet.

**January 18, Tuesday**  
Classes begin, Kingston Campus and CCE. Final date for January degree candidates to submit master's and doctoral theses in final form and successfully defended. NO EXTENSIONS OF TIME WILL BE GRANTED.

**January 31, Monday**  
Final date to add courses, and for P-F option or audit requests. *Fees will not be adjusted downward for courses dropped after this date.*

**February 1, Tuesday**  
Final date for nominations for May graduation and for submission of annual review of doctoral candidates. Final date for completion of admissions applications for individuals seeking financial aid for 1994. Applications for financial aid received subsequent to this date cannot be assured of full consideration.

**February 15, Tuesday**  
Final date for nominations from departments for all financial assistance awarded by the Graduate School.

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**February 21, Monday**  
Classes will not meet.

**February 22, Tuesday**  
Monday classes meet.

**March 8, Tuesday**  
Midsemester. Final date to drop courses and change from P-F option to grade.

**March 14, Monday**  
Spring recess begins, 8 a.m.

**March 21, Monday**  
Classes resume, 8 a.m.

**March 30–April 2**  
Currently enrolled matriculating graduate students may pick up advance registration materials for fall 1994 from the Office of the Registrar.

**April 5–April 30**  
Currently enrolled matriculating graduate students may register for fall 1994 by telephone anytime after their earliest time to register.

**April 14, Thursday**  
Final date for May degree candidates to submit completed master's and doctoral theses in a form acceptable for examination purposes, along with the request for oral defense of theses. **NO EXTENSIONS OF TIME WILL BE GRANTED.** Theses must be submitted at least 20 calendar days prior to the date requested for the oral defense. Selection of date should allow sufficient time for necessary revisions and retyping before submission in final form. See deadline below.

**April 15, Friday**  
Application deadline for summer 1994 admissions, except for programs with earlier deadlines.

**May 3, Tuesday**  
Classes end, Kingston Campus. Programs of study due for students admitted in January 1994.

**May 4–5**  
Reading days, Kingston Campus.

**May 6, 9–13**  
Final examinations, Kingston Campus.

**May 13, Friday**  
Final date for all May degree candidates to submit master's and doctoral theses in final form and successfully defended. **NO EXTENSIONS OF TIME WILL BE GRANTED.**

**May 10, Tuesday**  
CCE classes and examinations end.

**May 16, Monday**  
Final grades due in the Office of the Registrar by 4 p.m.

**May 21, Saturday**  
Graduate Commencement.

## Summer Session 1994

**NOTE:** All courses taken by graduate students during summer sessions are subject to the same regulations regarding inclusion in programs of study and calculation of overall academic average, etc., as courses taken during the regular academic year. Students wishing to take directed studies or special problems courses during summer sessions must obtain individual approval for these courses from the Summer Session Office unless the specific offering is listed in the Summer Session Bulletin for that year. Students wishing to enroll for thesis or dissertation research during summer sessions must first determine that their major professors and/or members of their thesis or dissertation committees will be available and are willing to provide the necessary supervision. See also the important note at the end of this calendar regarding scheduling of examinations, including defenses of theses, during summer session. See the Summer Session Bulletin available at the Summer Session Office.

**June 3, Friday**  
Final date for nominations for August graduation.

**July 15, Friday**  
Deadline for fall 1994 applications, except for programs with earlier deadlines. Final date for all August degree candidates to submit completed master's and doctoral theses in a form acceptable for examination purposes, along with the request for oral defense of theses. **NO EXTENSIONS OF TIME WILL BE GRANTED.** Theses must be submitted at least 20 calendar days prior to the date requested for the oral defense. Selection of date should allow sufficient time for necessary revisions and retyping before submission in final form. See deadline below.

**August 12, Friday**  
Final date for all August degree candidates to submit master's and doctoral theses in final form and successfully defended. **NO EXTENSIONS OF TIME WILL BE GRANTED.**

**August 31, Wednesday**  
Deadline for international students to arrive on campus.

**IMPORTANT NOTE:** Requests for scheduling examinations must be submitted to the Graduate School Office at least 20 calendar days prior to the date(s) requested. Theses and dissertations must be distributed to members of the examining committee at least 15 days prior to the date of the defense. Oral and written examinations, including qualifying and comprehensive examinations and defenses of theses, will be scheduled only at the convenience of the faculty members involved and depending on the availability of the candidate's program committee and additional qualified examiners. Such examinations will not be scheduled during periods when the University is in recess. Students wishing to take any examinations should first check as to the availability and convenience of the faculty members. Each faculty member must initial the request for scheduling the examination to indicate willingness to serve. The faculty should be consulted well in advance for examinations being scheduled during the winter intersession and summer session. If they are not registered for course work or research during the summer sessions, students should register for one credit of research to defend theses and for continuous registration to take the other examinations. Please note that persons on continuous registration do not have the privilege of consulting regularly with professors on research or thesis preparation, nor of using the University's laboratory, computer, or other educational facilities (except for the libraries).

# THE UNIVERSITY

**T**he University of Rhode Island is a medium-sized state university located in the southern part of Rhode Island in the village of Kingston. It was founded as a land-grant college in 1892. As the institution expanded, a wide range of educational and scholarly programs were developed. In part because of its location near the ocean, the University has developed strong marine programs and has been designated one of the national Sea Grant colleges.

The University enrolls about 12,400 students on its Kingston Campus, and another 3,000 in credit courses throughout the state. There are about 12,000 undergraduate students, about 3,700 graduate students, and a full-time teaching faculty of about 720.

The University has nine colleges and three schools: the Colleges of Arts and Sciences, Business Administration,

Continuing Education, Engineering, Human Science and Services, Nursing, Pharmacy, Resource Development, and University College; the Graduate School, the Graduate School of Library and Information Studies, and the Graduate School of Oceanography.

**Mission Statement.** The University of Rhode Island is rooted firmly in the tradition of America's unique land-grant institutions—universities that exist to expand and transmit knowledge and to foster its application in the daily life of the nation.

As the state's flagship institution of higher learning, the University has three major responsibilities: to provide traditional as well as innovative opportunities for education at the undergraduate and graduate levels; to pursue research and other scholarly and creative activities; and to serve the unique

needs of the people of Rhode Island by making knowledge and information readily available to individual citizens, to community groups, to school and educational agencies, and to business, industry, labor, and government.

At the heart of this university, like its counterparts across the nation, there is a strong core of traditional academic disciplines, such as history, physics, and economics. These are not only principal subjects of teaching and research, but they also provide the foundation for all specialized, professional, and applied areas of study.

One component of the University's approach to higher learning is the close student-teacher relationship and the consequent concern for the individual person. A low student-to-faculty ratio enhances the success of this vital component of the University's mission.



Because of its commitment to provide access for academically qualified and motivated students of all ages, the University maintains a variety of both traditional and nontraditional learning environments. Students who are part time, disabled, or somewhat older than traditional students, who are members of a minority group or are working while pursuing an education—such students are served through a wide range of facilities in Kingston as well as through extensive academic and student services at the University's College of Continuing Education in Providence.

**Campuses.** The University has a spacious rural campus in Kingston, 30 miles south of Providence, in the north-eastern metropolitan corridor between New York and Boston. The center of the campus is a quadrangle of handsome old granite buildings surrounded by newer academic buildings, student residence halls, and fraternity and sorority houses. On the plain below Kingston Hill are gymnasiums, athletic fields, tennis courts, and agricultural fields.

In addition to the Kingston Campus, the University has three other campuses. The Narragansett Bay Campus, six miles east of Kingston, overlooking the West Passage of the bay, is the site of the Graduate School of Oceanography. On its 165 acres are located academic and research buildings, a pier for research vessels, the Rhode Island Nuclear Science Center, and several federal laboratories devoted to the marine sciences. The College of Continuing Education, with main offices at 199 Promenade Street in Providence, offers courses throughout the state. The W. Alton Jones Campus, in the western section of the state, 20 miles from Kingston, has 2,300 acres of woods, fields, streams, and ponds devoted to environmental education and research. Conference facilities are also located on the campus.

## Graduate Study

Graduate study at the University was inaugurated in 1907 with Master of Science degrees in chemistry and engineering. The Master of Arts degree was first awarded in 1951, and in 1960 the University awarded its first Doctor of Philosophy degree. Graduate work for

professional degrees was initiated in 1962, when the degree of Master of Public Administration was first awarded. Today, the master's degree is offered in 56 areas of study and the doctorate in 35 areas. To date, over 14,500 master's degrees and 1,600 doctoral degrees have been conferred.

The Dean of the Graduate School has primary responsibility for administering policies and procedures relating to advanced study at the University of Rhode Island. Graduate School policy is formulated by graduate faculty members, acting through their delegate body, and the Graduate Council, which includes student members. Only the Dean or the Graduate Council can grant exceptions to the regulations for graduate study, which are explained in detail in the *Graduate Student Manual*.

The University graduate programs of study are listed on page 6. Work in a combination of special areas is often possible. Graduate-level course work applicable to a number of these programs is offered in several locations throughout the state by the College of Continuing Education. In most cases, however, a portion of the courses must be taken on the Kingston Campus.

## Research

Within Rhode Island's system of higher education, the University has the major responsibility for graduate study, which is closely associated with a strong program of research. Specialized research, education, and public service projects are conducted in all departments and programs offering graduate degrees. Sponsored research throughout the University is supported by a total of approximately \$43 million per year. Support comes from foundations, commercial firms, and federal and state government. The University ranks among the top five percent of the country's colleges and universities in the amount of research funding received.

The vice provost for research and services, on behalf of the University, signs applications for research grants, maintains files of funding agencies, keeps a current facilities inventory, and is a liaison for the president, the business manager, the academic deans, the Research Committee, and the faculty in matters pertaining to general research policy.

## Research Resources

**University Libraries.** The library collection of 1,010,000 bound volumes and 1,300,000 microforms is housed in the University Library in Kingston, at the College of Continuing Education in Providence, and in the Claiborne Pell Marine Science Library on the Narragansett Bay Campus. The latter was designated the National Sea Grant Depository in 1971.

The University Library, which holds the bulk of the collection, has open stacks with direct access to books, periodicals, documents, maps, microforms, and audiovisual materials. The Special Collections Department collects and maintains rare books, manuscripts, the University archives, and a variety of special interest materials. Service hours at the other libraries vary, but the University Library provides full reference, bibliographic, and circulation services during most of the 90 hours per week it is open. Terminals linked to the Academic Computer Center are available in the library during the hours both facilities are open. A computer-based bibliographic system makes most books available to users one week after their receipt. Arrangements can be made to borrow out-of-print material from other libraries through the Interlibrary Loan Office in the University Library.

The University is a member of the Higher Education Library Information Network (HELIN), which extends borrowing privileges to the faculty, staff, and students of the Community College of Rhode Island, Providence College, Rhode Island College, Roger Williams University, and the University of Rhode Island. Holdings of all these libraries are included in the on-line public access catalog.

**Academic Computer Center.** The Academic Computer Center (ACC) provides computational resources needed by the University community for instruction and research. Located in Tyler Hall on the Kingston Campus, the ACC maintains central computing facilities, supports microcomputing activities, provides facilities management and data communications assistance to departmental systems, and offers a wide variety of support services in these areas. The computer network and related services have been expanding steadily since the center opened in 1959, and

## Graduate Degree Programs

### Master of Arts

Audiology  
Comparative Literature  
Education  
• Adult Education  
• Education Research  
• Elementary Education  
• Reading Education  
• Science Education  
• Secondary Education  
English  
French  
History  
Marine Affairs  
Philosophy  
Political Science  
Spanish  
Speech-Language Pathology

### Master of Science

Accounting  
Audiology  
Biochemistry  
Botany  
Chemical Engineering  
Chemistry  
Civil and Environmental Engineering  
Clinical Laboratory Science  
Computer Science  
Electrical Engineering  
Entomology  
Fisheries, Animal and Veterinary  
Science  
Food Science and Nutrition  
Geology  
Human Development and Family  
Studies  
• Human Development and Family  
Studies  
• Marriage and Family Therapy  
• College Student Personnel  
Labor and Industrial Relations  
Manufacturing Engineering  
Mathematics  
Mechanical Engineering and Applied  
Mechanics  
Medicinal Chemistry  
Microbiology  
Natural Resources  
Nursing  
Ocean Engineering  
Oceanography  
Pharmaceutics  
Pharmacognosy  
Pharmacology and Toxicology  
Pharmacy Administration  
Physical Education  
Physical Therapy  
Physics  
Plant Science  
Psychology (School)

Resource Economics  
Speech-Language Pathology  
Statistics  
Textiles, Fashion Merchandising, and  
Design  
Zoology

### Doctor of Philosophy

Applied Mathematical Sciences  
• Applied Mathematics  
• Applied Probability  
• Computer Science  
• Operations Research  
• Statistics  
Biological Sciences  
• Biochemistry  
• Botany  
• Fisheries, Animal and  
Veterinary Science  
• Food Science and Nutrition  
• Microbiology  
• Natural Resources  
• Plant Pathology  
• Plant Science  
• Zoology  
Business Administration  
Chemical Engineering  
Chemistry  
Civil and Environmental Engineering  
Economics—Marine Resources  
Electrical Engineering  
English  
Mathematics  
Mechanical Engineering and Applied  
Mechanics  
Nursing  
Ocean Engineering  
Oceanography  
Pharmaceutical Sciences  
• Medicinal Chemistry  
• Pharmaceutics  
• Pharmacognosy  
• Pharmacology and Toxicology  
Physics  
Psychology  
• Clinical  
• Experimental  
• School

### Professional Degrees

Master of Business Administration  
(M.B.A.)  
Master of Community Planning  
(M.C.P.)  
Master of Library and Information  
Studies (M.L.I.S.)  
Master of Marine Affairs (M.M.A.)  
Master of Music (M.M.)  
Master of Public Administration  
(M.P.A.)

now a majority of the students, faculty members, and staff use the facilities.

The center has an IBM ES/9000-210VF mainframe computer running the VM/CMS operating system to provide computing support in both interactive and batch-processing modes. A full complement of programming languages and packages is available. Extensive computer graphics facilities are also offered using both video display facilities and a CalComp 58436 color electrostatic plotter for visualization. Self-service printers are available at remote locations. Several hundred personal computers, workstations, and terminals are located in public work areas and private offices. These devices are connected to a MICOM data switch or the University Ethernet network, which provides access to the ACC systems and remote independent computers. Also available are extensive dial-up facilities as well as external network access to the National Science Foundation Network and BITNET, the international network for educational centers. URI is also a Smart Node member of the Cornell National Supercomputer Facility, with both research and educational access to supercomputer facilities.

The ACC provides facilities management services for campus microcomputer laboratories featuring IBM PS/2s, Apple Macintoshes, and UNIX workstations. Numerous software applications are available. The microcomputer laboratories are available for faculty research, teaching, and student course work. Eight computer classrooms are available.

**Other Research Facilities.** The Department of Computer Science and Statistics operates both research activities and instruction within the department. At present, this facility includes a classroom equipped with 36 Macintosh computers, another classroom with 12 SUN workstations, and a VAX minicomputer. Additional SUN workstations and Macintoshes are located in faculty and graduate student offices. All of the equipment is interconnected by a local area network. The Narragansett Bay Campus has a Prime 750 and a Microvax II for timesharing use, an educational computer laboratory with nine Macintosh computers, two DOS machines, two SUN workstations, and a high-speed data link to the Academic Computer Center. The College of Engi-

neering has a VAX 4000/200 VMS minicomputer; a DECsystem 5000/200 RISC Ultrix server; 20 VAXstation 3100 graphics workstations; 75 IBM-compatible PCs (286i and 486i); and terminals in all engineering buildings. These and all other departmental computers are linked together by an internal college Ethernet network. Ethernet connects to the campus network, which includes the Academic Computer Center and the international INTERNET. The Department of Electrical Engineering has a SUN 4/490 SPARC server, 42 SUN and DEC Unix workstations, and a variety of PCs and Macintoshes. The Department of Civil Engineering has a VMS cluster of four VAXstation 3100 graphics workstations and a Novell network of eight IBM PCs. The Department of Chemistry has a VAX 4000/200 VMS minicomputer, one HP and three DEC Unix workstations, 20 IBM-compatible PCs, and six Macintoshes.

Four other computer facilities are available in the College of Business Administration. The Dennis W. Callaghan Microcomputer Lab, housed in the College of Business Administration, has 35 networked IBM-compatible 286i PCs and 12 Textronics 4307 terminals with access to the Novell file server and the campus-wide computer system network. The Champlin Room facility offers higher processing power with an IBM PS/2 model 70/386. This extensive computer capability is duplicated at the College of Continuing Education in Providence, on a somewhat smaller scale, so that both day and evening students can avail themselves of the latest in computer technology.

Other equipment includes major laboratories for digital pattern recognition and digital image processing, computer automation ("robotics"), optical properties of materials and microelectronics, and materials research, a mechanical properties testing facility, including an Instron 1125, several MTS SERVO-HYDRAULIC testing machines and a NETZSCH thermal analyzer, a field station for radiopropagation research, and reverberant and anechoic rooms for airborne acoustics work.

Equipment available for marine research includes chambers for leak-testing equipment prior to deep-sea use, marine geotechnical laboratory facilities for sediment testing, a wave and towing tank, underwater acoustics test facilities, a marine experimental aquari-

um, a marine ecosystem laboratory, and an oceanographic remote-sensing laboratory that processes sea surface data. The University also operates the Ocean Mapping Development Center for mapping the sea floor.

The University's research vessel, *Endeavor*, operated by the Graduate School of Oceanography, is a 177-foot ship capable of working in all parts of the world's oceans. It can carry a scientific party of 16. Also part of the fleet are a 59-foot, high-speed ocean research vessel, the *Laurie Lee*, and a 65-foot ocean engineering vessel, the RV *Edson Schock*, with equipment for imaging and sampling the sea bed. The University fisheries school operates a 52-foot-long training vessel, the *Captain Bert*. A number of smaller vessels are also available. The Graduate School of Oceanography also has a fully equipped research diving facility.

A research reactor and associated facilities are available to University students at the Rhode Island Nuclear Science Center, located on the Narragansett Bay Campus. Constructed and operated by the state of Rhode Island, this critical reactor is extensively used for research by many departments of the University. The reactor, designed for 5MW, is now operating at 2MW. Hot laboratories, counting equipment, neutron spectrometers (including a unique polarized-beam, small-angle instrument), and multichannel analyzers are also available.

The College of Nursing has practice laboratories equipped with a heart-sound simulator used by students in primary health care. The media center at White Hall contains various types of learning modules and microcomputers for research and instruction.

Housed in the Morrill Science Building, the URI Central Electron Microscope Facility has a JEOL 1200 EX scanning-transmission electron microscope (STEM). This is a high-resolution microscope with transmission, scanning, scanning transmission, and diffraction capabilities. Ultramicrotomes, carbon evaporators, darkroom facilities, and other equipment for specimen preparation are also available. The facility is available for use by graduate students and other University personnel, and for research projects and instruction. The facility is staffed by a director and a technical specialist who maintains the facility and assists and trains users.

Advice in project design is also provided, and assistance with biological preparation is available by special arrangement. The facility welcomes projects of all sorts, in both the biological and physical sciences.

The Physical Therapy Program in the Keaney-Tootell complex has established a clinical research unit that includes a computerized BIODEX muscle performance testing dynamometry system, a METRECOM postural analysis system, and an ARIEL biomechanical analysis system for human motor performance assessment. Functional electrical stimulation for the spinal-cord injured and other neurologically impaired patients is made possible through a cooperative arrangement with the nonprofit organization, Shake-A-Leg, Inc. Clinical evaluation, treatment, and collaborative studies are possible in exercise science through cooperation with researchers in the Department of Physical Education, Health, and Recreation.

The Speech and Hearing Center has one-way vision and listening facilities and diagnostic equipment for speech and language testing. Sound-treated testing rooms meeting ANSI standards and audiometric equipment provide for audiologic evaluation and research.

**Writing Center.** The Writing Center provides assistance to anyone in the University community who needs help with any phase of writing a paper. The Writing Center is staffed by the Department of English College Writing Program faculty, Department of English graduate students, and undergraduate peer tutors. Tutoring is provided by appointment on an individual basis.

The center helps students become better writers and provides an environment in which writers can write with paper and pencil or on one of the center's Macintosh computers. Students can use an array of software, including word-processing software, to produce their work with support from center staff. The computers and software in the Writing Center are compatible with those in other labs campus-wide.

The Writing Center is open approximately 40 hours per week, including daytime and evening hours. Appointments for tutoring can be made by calling 401-792-4690, or by visiting the center in Room 313, Independence Hall.

## Research Units

In addition to the research in various departments, the following special research agencies have been established.

**Agricultural Experiment Station.** This station within the College of Resource Development is the designated Rhode Island/USDA partnership organization for research in the agricultural sciences. Basic and applied investigations in natural and human resources are carried out by 54 senior scientists assigned to college departments. Their research promotes conservation and management of resources, improvement of the quality of environment, enhancement of home life, and support of resource-using business and industry. A strong orientation toward estuarine and marine issues and an interdisciplinary approach to resource research are characteristics of the station. The progress of research and complete results of individual projects are published in station bulletins, which are available to Rhode Island residents upon request.

**Aquaculture Center, East Farm.** The Department of Fisheries, Animal and Veterinary Science maintains a facility for the study of fish biochemistry, physiology, and pathology at East Farm, near the main campus. The 2,000-square-foot building houses circular fiberglass rearing units, bioassay tanks, and smaller tanks for individual studies. Although the research emphasis is on Atlantic salmon—the center rears 40,000 salmon in its tanks—there are also rearing tanks for lake, brook, and rainbow trout. In addition, the center maintains a net pen with 3,000 Atlantic salmon at Casey Point in Saunderstown, about nine miles from the main campus.

**Biotechnology Center.** This center was established to coordinate and foster interdisciplinary research in the agricultural, medical, marine, and food sciences and their supporting basic science disciplines. It provides a structure to encourage interaction among the academic, governmental, and industrial sectors of the state economy. The center identifies new research opportunities and organizes seminars and workshops on topics in biotechnology. While the center is not an academic unit of the University, it identifies

potential study areas in biotechnology for the various departments of the University at the graduate and undergraduate levels. It is administered in the College of Resource Development by a steering committee with a chairman selected from the college.

**Center for Atmospheric Chemistry Studies (CACs).** The center, part of the Graduate School of Oceanography, is a focal point for the development of a broad-scale research effort in the transport, reactions, and impact of substances carried through the atmosphere. It provides a resource in the research of atmospheric chemistry and air pollution for the state of Rhode Island, and participates in several multi-institutional, multinational research programs investigating global-scale problems in atmospheric chemistry.

**Child Development Center (CDC).** The CDC is part of the Department of Human Development and Family Studies. It serves as a research site, with the children, their families, and staff participating in studies conducted by University faculty and students. Investigations focus on a range of topics related to the social, emotional, physical, and cognitive development of young children; the creation and management of early-education environments; and relationships between teachers and children, teachers and parents, and parents and children.

**Coastal Resources Center (CRC).** Since 1971, CRC has been dedicated to developing strategies for the effective management of coastal environments. It prepared the state's Coastal Management Program, assisted the New England Regional Commission in the resolution of issues posed by offshore oil development, and prepared Special Area Management Plans for critical areas of Rhode Island. In 1984, CRC assumed the leadership of an interdisciplinary study of major U.S. estuaries, a study that is assessing trends in their use and evaluating existing governance policies. A major international program was started in 1985 to assist developing nations in the management of their coastal zones, and CRC, through a cooperative agreement with the U.S. Agency for International Development, has been helping Ecuador, Sri Lanka, and Thailand develop coastal management programs for their countries. As part of its central activity of formulating management strategies, CRC designs research projects to improve the understanding of specific resource issues, provides technical assistance and training, and develops programs that involve the public in coastal management initiatives.

**Cooperative Extension.** This nationwide outreach education system was established by federal legislation and is a partnership of the U.S. Department of Agriculture, state land-grant universi-



ties, and local governments. District offices are located in East Greenwich (serving Kent and Washington Counties), Greenville (Providence County), and Newport (Newport and Bristol Counties). The mission of Cooperative Extension at URI, which is housed in the College of Resource Development, is to teach people how to improve their lives and their communities using scientific information produced by the University's research centers. It addresses the economic, social, and environmental issues important to Rhode Island citizens and covering these broad areas: home economics and family living, 4-H youth development, and agricultural and community resource development.

**Design for Manufacture Research Center.** The center is based in the Department of Industrial and Manufacturing Engineering. It involves undergraduates, faculty members, and graduate research assistants, at both master's and doctoral levels. Center research is concerned with the relationships between product design decisions and manufacturing efficiency. Topics considered include product structure analysis, comparison of material and process selections, and product design for manufacturing automation. The center's goal is to produce database analysis tools that can be used by product development teams. Funding is provided by the National Science Foundation and various industries in the United States.

**Environmental Data Center (EDC).** The EDC is a spatial data analysis laboratory in the Department of Natural Resources Science. The EDC specializes in using Geographic Information System data-processing tools to solve environmental problems. The lab is one of the custodians of the Rhode Island Geographic Information System database, which consists of accurate and up-to-date cartographic data on Rhode Island's soils, wetlands, land use, geology, hydrography, and numerous other categories of information. These data are available to the URI academic community for teaching and research applications. Students and research staff of the laboratory are currently engaged in research projects with the Rhode Island Department of Environmental Management, the Environmental Protection Agency, the National Park Service, the

Soil Conservation Service, and the National Oceanic and Atmospheric Administration. Lab computing is done on Data General AViiON workstations, microcomputers, and the University's IBM mainframe. The EDC maintains a Global Positioning System base station and has hardware and software for processing remotely sensed data.

**Exercise Science Laboratories.** These laboratories consist of the Human Performance Laboratory, the Kinesiology Laboratory, and the Computer Laboratory, all housed in the Tootell-Keaney complex. They offer measurement and exercise counseling services to local, state, and regional agencies, industrial corporations, established exercise programs, athletic teams, and individuals with medical referrals. They serve as teaching and research units for undergraduate and graduate students focusing on exercise science and fitness. In addition, the Independence Square II building houses three exercise science laboratories, a Cardiopulmonary Laboratory, an Energy Metabolism Laboratory, and a Microscopy/Image Analysis Laboratory dedicated to faculty and student research. The Cardiopulmonary Laboratory also serves the clinical programs in cardiac rehabilitation and community fitness.

**Food Science and Nutrition (FSN) Research Center.** The FSN Center has been designed to house all the graduate education and research programs in food science and nutritional science. The center is administered by the College of Resource Development and is located in West Kingston. In addition to its own microcomputer facilities, the center has 16 fully equipped research laboratories, including those dedicated to carotenoid chemistry, vitamin A, nutrient interaction, food bioprocessing, physical properties of food, industrial microbiology, food chemistry, and food safety. There is a research winery with its own walk-in cold room and incubators. The Animal Laboratory conforms to all federal codes for animal research, with separate rooms available for toxicological, radioactive, and growth studies. The center also has both food processing and seafood processing pilot plants. It has the facilities and equipment to provide instruction, research, and service in the fields of food science and nutrition.

**Historic Textile and Costume Collection.** A historic costume and textile collection of over 16,000 items is housed in the Department of Textiles, Fashion Merchandising, and Design. The collection, of national significance, contains quilts, coverlets, samplers, shawls, ethnic textiles, and costumes dating from the late 18th through the 20th centuries. Faculty and a full-time curator are available to assist scholars and museum professionals with problems of classification, identification, conservation, and storage of textile artifacts. The department also houses a textile conservation laboratory with facilities to wet clean, stabilize, and repair historic textiles and costumes.

**Institute for International Business.** The institute seeks to encourage and support interdisciplinary research, education, and training in the field of international business, drawing on University faculty and outside resources to serve the needs of the business community and to enrich the academic and outreach programs of the College of Business Administration. The institute attempts to coordinate its efforts with those of other University offices, centers, and programs concerned with international research and education.

**Institute of Human Science and Services.** The institute sponsors research and support activities in the human sciences and services, particularly in the areas of evaluation, measurement, survey research, curriculum development, training, and human services policy and management. Institute activities focus on areas including education, human development, the family, gerontology, exercise science, consumer affairs, counseling, and public policy. The institute is an integral part of the College of Human Science and Services and draws its professional staff from all departments of the college. The institute maintains a close liaison with human service agencies such as the Rhode Island Department of Education, Rhode Island Social and Rehabilitative Services, and the Rhode Island Institute of Mental Health, Rehabilitation, and Hospitals.

**Intergovernmental Policy Analysis Program (IPAP).** Created by the University in 1978 as a means to improve the responsiveness of the University to the needs of state government, IPAP is

currently organized as an office under the provost. As a research unit, IPAP works to provide an innovative program that can meet many of state government's critical and short-term needs as well as long-term requirements. Since its inception, IPAP has received grants from state government agencies to assist in research design, resource development, and policy analysis, and has coordinated the state's Executive and Legislative State Science, Engineering, and Technology Programs with funding from the National Science Foundation. In addition, other grant projects have been funded by regional and federal governments and by private research organizations.

#### **Kirk Applied Engineering Laboratory.**

The filtration research laboratory at the University of Rhode Island is one of a few laboratories nationwide studying filtration processes from a fundamental point of view. At the heart of this center is a generous donation of equipment made by the Fram Corporation, a division of the Allied Corporation. This includes a two-channel, computer-controlled laser anemometer system, a SUN workstation, and two Apollo computers, a low-turbulence level wind tunnel, a water channel, extensive instrumentation for the generation and analysis of aerosols, and a variety of other instrumentation and equipment. The laboratory is housed in the Kirk Building, has associated faculty from the Departments of Mechanical and Chemical Engineering, and has access to other expertise within the College of Engineering and the University, as needed. The laboratory excels in its focus on developing a basic scientific understanding of filtration and separation processes, and in its intention to maintain close ties with the industrial applications for its work.

**Labor Research Center.** The Labor Research Center is a tripartite, independent, multidisciplinary unit devoted to the study and teaching of subjects broadly defined as labor and industrial relations. The center is concerned with research and service as well as the administration of the graduate program leading to the M.S. degree in labor and industrial relations. More than 50 full-time University faculty members from three colleges and 13 departments are associated with the center in either a

teaching or research capacity. Labor, human resource management, and neutral external advisory committees work with the center's director and faculty in helping to define research and program needs and interests.

#### **Laboratories for Textile Performance Testing.**

These laboratories in the Department of Textiles, Fashion Merchandising, and Design are concerned with textile performance evaluation, fiber identification, dyeing and finishing problems, and quality control. The laboratory staff works closely with state and University purchasing agents and with the Rhode Island Attorney General's Office, and also provides technical assistance to industry. Equipment is available for performing a wide range of tests recommended by the American Society for Testing Materials, American Society for Quality Control, American Association of Textile Chemists and Colorists, as well as mandatory tests required by federal agencies.

#### **LANDSAT Remote Sensing Laboratory.**

This facility is a cooperative effort between the Graduate School of Oceanography and the Department of Marine Affairs and was established to use satellite remote sensing for terrestrial, coastal, and nearshore applications. Considerable emphasis is placed on the application of remote-sensing techniques to the solution of problems faced in both the public and the private sectors. Academic training and research concerning the classification of LANDSAT remote-sensing data are important functions of the laboratory, where individuals with differing research interests are provided opportunities to work together using state-of-the-art technology. The laboratory is staffed by professionals with in-depth backgrounds in satellite remote sensing.

#### **Marine Pathology Laboratory, East Farm.**

This laboratory, part of the Department of Fisheries, Animal and Veterinary Science, studies the diseases of aquatic animals, mostly to gauge the effects of pollution on natural populations. It offers diagnostic assistance to aquaculture researchers, and has a cooperative arrangement with the National Marine Fisheries Service. There is a large tank room of enclosed systems in which fish (tilapia, an important food fish in developing countries; fathead minnow; carp; goldfish; and

swordtails, among others) are exposed to variables such as heavy metals and bacteria to study the effects of these factors on the fishes' immune systems. Facilities include light and electron microscopes, a wet laboratory for both salt and freshwater fish, holding tanks, a postmortem laboratory, a bacteriology laboratory, and a fully equipped histopathology laboratory with a video monitoring system for microscopic analysis of tissue. Available to researchers is the laboratory's extensive slide collection of fish and sea turtles.

#### **Marriage and Family Therapy Clinic.**

This is an integral part of the graduate training program in marriage and family therapy in the Department of Human Development and Family Studies. Established in 1982, it is located at the Transition Center on Lower College Road. The Marriage and Family Therapy Clinic provides counseling services to families and clinical supervision to graduate students. It creates research opportunities for both graduate students and faculty members in family interaction and family systems. Various data-gathering devices are used to give feedback to families served and to graduate student therapists, and to produce a database for ongoing research. The clinic promotes the use of its facilities by local families and accepts referrals from the Rhode Island Family Court, school systems, clergy, and health personnel.

#### **National Sea Grant Depository.**

Housed in the Claiborne Pell Marine Science Library, the depository was established in 1971 to ensure that materials published under Sea Grant auspices would be available at a single location. Its subject matter touches widely diverse areas such as aquaculture, law, medicine, geology, chemistry, biology, engineering, mathematical modeling, food technology, information retrieval, recreation, coastal zone management, and market research. The National Sea Grant Depository publishes abstracts quarterly, makes available loan copies of Sea Grant documents, and conducts online literature searches.

#### **Office of Marine Programs (OMP).**

Housed in the Marine Resources Building, the OMP is responsible for the public education, institutional advancement, and communications and public relations activities of the Graduate

School of Oceanography. The OMP manages the Narragansett Bay Classroom, Friends of Oceanography, GSO alumni affairs, campus tours and public events; coordinates the JASON Project; and oversees the publication of the *GSO Curriculum Bulletin*, *Maritimes*, and *At the Bay Campus*. The OMP also serves as the administrative home of the URI Marine Programs Advisory Council and the National Sea Grant Depository.

**Office of Research Enhancement (ORE) in the College of Nursing.** ORE is a partnership between the College of Nursing and nursing practice settings to provide initiatives for clinical research and education. It supports an environment that encourages mutual respect, inquiry, and education in each encounter and provides curriculum content for students, care givers, and faculty. Its goals are to 1) teach research-related skills, 2) provide access to nursing research, 3) disseminate research findings and apply them to clinical practice, and 4) promote clinical investigations among nurses by establishing nurse scientists and clinical research teams. Clinicians and students work along with faculty in research studies by identifying problems, helping the faculty researchers gain access to clinical sites, influencing instrument development, and collecting data.

**Pacific-Basin Capital Markets (PACAP) Research Center.** The PACAP Research Center is dedicated to creating, maintaining, and distributing capital market databases for 11 nations in the Pacific-Basin region; promoting academic research and teaching programs for a better understanding of the region's capital markets; and providing an international forum for global communities of business, government, and academia to exchange research ideas and findings and disseminate relevant information that affects the region. The center also organizes the PACAP Finance Conference each year. Through the many programs launched by the PACAP Research Center, URI maintains close relationships with stock and futures exchanges in the Pacific-Basin region and in the United States, multinational brokerage houses, and leading universities in Asia. URI is now the primary source of Asian capital markets databases and is a driving force for academic research on Pacific-Basin capital markets.

**Research Center in Business and Economics.** The center provides research support for the College of Business Administration faculty and conducts research projects for external organizations. It compiles the state's Index of Leading Economic Indicators, conducts the statewide Consumer Confidence Polls, and manages all research for the Rhode Island Defense Economic Adjustment Project. It has also provided survey research, concept testing, and other analytic services to a variety of external organizations.

**Research Institute for Telecommunications and Information Marketing.** The institute fosters, encourages, and supports research and education in telecommunications and information marketing, drawing on University faculty and outside resources to serve the needs of the business community and to enrich the academic and outreach programs of the College of Business Administration. The institute is administered outside the departmental structure under the leadership of a director who reports to the dean of the College of Business Administration.

**Rhode Island Sea Grant College Program.** Established in 1968 in the Graduate School of Oceanography, the Sea Grant Program acts as a focal point in a partnership that includes government, industry, and the University in an effort to increase scientific understanding of the oceans and coastal waters, improve management of marine resources, and promote development of marine products. The program consists of research, education, and advisory services, and is funded by the National Oceanic and Atmospheric Administration (NOAA) in the Department of Commerce.

**Rhode Island Sea Grant Marine Advisory Service.** The service is a federal and state collaboration in marine outreach. Marine specialists provide education and information and technology transfer programs to people in Rhode Island and New England who use the resources of the marine environment. Projects include working with commercial fishermen, seafood processors, marina and boatyard operators, local and state governments, and individuals and businesses interested in the management, use, development, or understanding of marine resources. Programs

promote better use of marine resources by encouraging cooperation among marine-oriented agencies and groups.

**Rhode Island Water Resources Center.** This is the state center for research and training in all phases of water resources. Similar centers in each of the 50 states and the District of Columbia as well as Guam, Puerto Rico, and the Virgin Islands were established by law in 1964 and work cooperatively with the federal government in an effort "to assist in assuring the nation at all times of a supply of water sufficient in quantity and quality to meet the requirements of its expanding population." The center, which is housed in the Department of Civil and Environmental Engineering, also works with faculty members of other University departments, with faculty members of other Rhode Island academic institutions, and with state agencies.

**Robotics Research Center.** The center involves undergraduates, master's and doctoral degree candidates, staff, visiting engineers, and faculty in the Departments of Electrical, Mechanical, and Industrial and Manufacturing Engineering. Their research deals with the application of advanced sensor-based systems, including robots, to flexible manufacturing workstations that deal with parts and components of a scale that can be normally handled by humans. Research in robotics began at the University in 1971 and was expanded in 1975 when the National Science Foundation (NSF) provided a significant level of long-term funding. In 1980, the Industrial Participation Program was initiated; it consists of companies involved both in the production of robots and in their employment in the production process. The NSF provided further funding in 1982 by establishing the only NSF University/Industry Cooperative Research Center in Robotics. The center is housed in the Kirk Applied Engineering Laboratory building.

**Small Business Development Center (SBDC).** The center, which is part of the College of Resource Development, uses the services of URI faculty and private consultants to provide assistance to small businesses throughout the state in accounting, finance, marketing, product development, and personnel concerns. The SBDC also develops and

presents seminars and courses for small business owners and entrepreneurs on topics such as financial management, marketing management, computers for the small business, sources of capital, and sales management.

**Social Sciences Research Center.** This building, constructed in 1991, houses several programs involved in research in the social sciences. The *Family Violence Research Program* focuses on the study of the physical, emotional, and sexual violence between family members and intimates. The *Cancer Prevention Research Center* and *Self-Change Laboratory* comprise a multidisciplinary research facility aimed at accelerating the rate of change of behavior that will result in the prevention or the early detection of cancer. The *Community Research and Services Team* evaluates alcohol and other drug abuse prevention programs around the state of Rhode Island. The *Women's Health Research Project* focuses on issues related to women's health; specifically, HIV prevention, substance abuse, and sexual abuse.

**Thin Film Laboratory.** This laboratory is supported by a number of government agencies and private corporations, including the Rhode Island Center for Thin Film and Interface Research. Its primary focus is to develop new thin film materials with unique properties and to design thin film coatings for specific applications. These applications include novel microelectronic devices; thin film sensors to measure pressure, strain temperature, radiation, and moisture; corrosion- and oxidation-resistant coatings; phosphors and electrodes for flat panel displays; and thin film dielectrics for waveguides and capacitors. The laboratory facilities include state-of-the-art equipment for the disposition and characterization of thin film materials and devices. This equipment includes a Perkin-Elmer Surface Analyzer complete with SIMS, ESCA, Auger capability and an ISI-SEM with chemical analysis. Complete microlithography facilities also exist within the Thin Film Laboratory, which can design and generate photomasks capable of extremely fine geometries.

**Urban Field Center.** Located in the city of Providence, the Urban Field Center is a part of the graduate curriculum in community planning and area development in the College of Resource Development. A major goal of the center is the development of applied research and technical assistance skills for city educational systems, community groups, and the state agencies of Rhode Island. The center has developed an agenda for community service in collaboration with an advisory committee, the state agencies, and community groups.

**URI-NOAA Cooperative Marine Education and Research (CMER) Program.** The CMER Program was established when the University was designated a Center of Excellence in Coastal Marine Studies by the National Oceanic and Atmospheric Administration (NOAA). The program's purpose is to foster closer interaction between elements of NOAA and the University, strengthening both organizations in the process and enhancing NOAA's ability to address issues of regional and national concern. The program is also intended to provide technical training in marine-related disciplines, primarily on the graduate and professional levels. Cooperative activities have included joint research and the posting of NOAA personnel as adjuncts to the University faculty.

## Accreditation

The University of Rhode Island is accredited by the New England Association of Schools and Colleges. In addition, certain courses and programs of study have been approved by national accrediting agencies.

The New England Association of Schools and Colleges is a nongovernmental, nationally recognized organization whose affiliated institutions include elementary schools through collegiate institutions offering postgraduate instruction.

Accreditation of an institution by the New England Association indicates that it meets or exceeds criteria for the assessment of institutional quality periodically applied through a peer group review process. An accredited school or college is one that has available the

necessary resources to achieve its stated purposes through appropriate educational programs, is substantially doing so, and gives reasonable evidence that it will continue to do so in the foreseeable future. Institutional integrity is also addressed through accreditation.

Accreditation by the New England Association is not partial but applies to the University as a whole. As such, it is not a guarantee of the quality of every course or program offered, or of the competence of individual graduates. Rather, it provides reasonable assurance of the quality of opportunities available to students who attend the University.

Inquiries regarding the status of an institution's accreditation by the New England Association should be directed to the administrative staff of the school or college. Individuals can also contact the association at the Sanborn House, 15 High Street, Winchester, MA 01890. Phone: 617-729-6762.

The national accrediting agencies that have approved the quality of certain course offerings and programs of study include the American Assembly of Collegiate Schools of Business, the American Association of Marriage and Family Therapy, the American Chemical Society, the American Council on Pharmaceutical Education, the American Institute of Certified Planners and Association of Collegiate Schools of Planning, the American Library Association, the American Psychological Association, the American Speech-Language-Hearing Association, the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology, and the National League for Nursing. The Doctor of Philosophy programs in clinical and school psychology are accredited by the American Psychological Association. In addition, the University has been authorized under federal law to enroll nonimmigrant alien students.

The University is also an approved member institution of the American Association of University Women, the American Council on Education, the Council of Graduate Schools, the North American Association of Summer Sessions, the National Association of State and Land-Grant Colleges, the Northeastern Association of Graduate Schools, and the National University Extension Association.

## Graduate Life

The main campus of the University of Rhode Island is located in the quiet, historic village of Kingston. Cultural variety and compact size are combined in the state of Rhode Island, and other cultural centers are easily accessible. Boston is 80 miles to the north and New York City 160 miles southwest. Bus service to these cities, as well as to Providence, Newport, and Cape Cod, is available from the campus. There is also a local bus service. The Kingston Amtrak station is two miles away.

**Services.** The recreational and cultural facilities of the campus are open to graduate students and include use of the Memorial Union building. Facilities there include meeting and conference rooms, lounges, a browsing room, study rooms, a darkroom, a radio station, campus newspapers, a games room, offices for student organizations, student technical services, a convenience store, a cafeteria, a restaurant, private dining rooms, a ballroom, a party room, and a scheduling and information office.

Services provided include a bookstore, a credit union, a travel agency, a unisex hair salon, a flower and gift shop, a pizza shop, an ice cream and pastry shop, and a center where copying facilities and typewriters are available. Student cooperatives under the direction of the Student Senate include a record shop, photography lab, housing directory, book exchange, and student hostel. There are substantial facilities for commuting students. A variety of small, privately owned shops and restaurants are within walking distance of campus.

Every effort is made to provide graduate students with opportunities for consultation and advice on matters of concern to them in their academic, extracurricular, and personal lives. Descriptions of available services and facilities, including those associated with religious life, may be found in the *Undergraduate Bulletin*. Of particular interest to graduate students are the following: Counseling Services and Career Services, both in Roosevelt Hall; Health Services, in the Potter Building; International Student Services, in the International Student Center; Religious Counselors, in Taft Hall, the Catholic Center, and Hillel House; and the Student Financial Aid Office, in Roosevelt Hall.

**Health Services.** University health services include special clinics in gynecology, family planning, internal medicine, surgery, orthopedics, nutrition, psychiatry, and dermatology, as well as general medical and nursing care, laboratory, X-ray, and pharmacy. Allergy injections are given, provided the vaccines are supplied.

Outpatient services during the academic year are available seven days a week, 24 hours a day, except for certain holidays and periods when the University is closed. Physicians are available either for direct services or on call. Nurses are on duty at all times during the academic year. Specialists are available by appointment only at specific times.

Hospital care is available in the local community. All medical expenses incurred outside the University's Health Services are the responsibility of the student. Therefore, students are encouraged to have adequate insurance coverage (see the Health Services brochure *To Your Health*). Students who choose their own private physician must assume responsibility for expenses incurred.

The Health Promotion and Education Department of Health Services is also located in the Potter Building and is concerned with teaching students to take care of themselves, to adopt healthy lifestyles, and to become informed consumers of health care services.

**Affirmative Action and Nondiscrimination.** The University of Rhode Island prohibits discrimination on the basis of race, sex, religion, age, color, creed, national origin, handicap, or sexual orientation, and discrimination against disabled and Vietnam era veterans, in the recruitment, admission, or treatment of students, the recruitment, hiring, or treatment of faculty and staff, and the operation of its activities and programs. This is in compliance with state and federal laws, including Titles VI and VII of the Civil Rights Act of 1964, as amended, Title IX of the 1972 Education Amendments to the Higher Education Act, Executive Order 11246, as amended, Sections 503/504 of the Rehabilitation Act of 1973, and Section 402 of the Vietnam Era Readjustment Assistance Act of 1974.

The Dean of the Graduate School, the director of Career Services, the director of the Counseling Center, and

the director of the (undergraduate) Special Programs for Talent Development cooperate to provide information and guidance for economically and socially disadvantaged individuals seeking opportunities for graduate study at the University. Inquiries may be directed to any of these offices.

Most buildings on campus are architecturally available to the disabled, and provision is made to ensure that no student is prevented from pursuing a course of study because of restricted access to buildings. Special counseling for physically, psychologically, or vocationally handicapped individuals is available from the Counseling Center.

Inquiries concerning compliance with antidiscrimination laws should be addressed to the Affirmative Action Officer, Carloti Administration Building, or to the Director, Office for Civil Rights, Department of Education, Region I.

**Students with Disabilities.** Approximately 500 students have identified themselves as disabled. A full range of services is offered by the University through the Office of Student Life. Individuals who need disability assistance, sign language interpretation, or use of an FM personal sound system for University programs or activities should call 401-792-2285 (TDD/voice) 72 hours in advance. For more information about individualized services and accommodations, please contact the assistant director of student life for disability services, 332 Memorial Union. Phone: 401-792-2101.

**Graduate Student Association (GSA).** This organization is interested in both the academic and the social aspects of graduate life. Officers and representatives of the association are elected annually from the entire graduate student body, and the association is represented on the Graduate Council. The GSA offices are located in the Memorial Union. Phone: 401-792-2339.

There are also organizations for spouses of graduate students and for students from foreign countries.

**Housing.** The Graduate Village and several other buildings provide 140 units of unfurnished apartments for graduate students. There is a waiting list for these units; interested students should write to the University Housing Office for applications and for additional information. The majority of off-campus

housing, located in nearby resort areas, is available only on a seasonal basis, from September to June. Since most of these rentals are five miles or more from campus, people without cars should investigate the availability of public transportation. A local bus service connects the shopping and service areas in Wakefield with the University. Some of the outlying resort areas, including Narragansett Pier, Galilee, and Scarborough, are also included in the bus routes.

Housing information may be obtained from the University Housing Office and from advertisements in the *Narragansett Times*, a local newspaper. In addition to providing information and applications for University housing, the Housing Office has available maps, bus schedules, rental booklets, and a graduate roommate file. A list of off-campus rooms, apartments, and houses available to graduate students is maintained in the Commuter Lounge at the Memorial Union.

Housing arrangements should be made as early as possible. The Housing Office is located in the Roger Williams Complex. Phone: 401-792-2215.

**Dining Services.** Dining services are available for graduate students at any of the University dining halls. Students who reside in University dorms are required to choose from one of the following options: any 10 meals Monday through Friday; any 15 meals Monday through Sunday; any 20 meals Monday through Sunday. Off-campus commuters and members of the campus community other than dorm residents may choose to purchase any five meals Monday through Sunday. Further information can be obtained by contacting the central office of Dining Services, Lippitt Hall.

**Academic and Social Codes.** Each student is a member of the University community, with all the rights, privileges, and responsibilities that go with such membership. The rights and privileges include full use of the educational opportunities and facilities offered on campus. The responsibilities include those of making proper use of these facilities in order to progress educationally, respecting the rights of others, and knowing and obeying the rules and regulations developed by the University community for the good of the total membership.

The University expects that all course papers, theses, and dissertations will be prepared, and all examinations taken, in conformance with accepted standards of academic integrity. This includes the proper citation and attribution of all material that is not the original product of the writer. It is the graduate student's responsibility to determine the appropriate style used in his or her discipline for presentation of material derived from other sources and to adhere to it scrupulously in all written presentations.

**University Ombud.** The ombud investigates complaints from students, faculty, and administrative personnel that they have been unfairly dealt with in the normal channels of administrative process. An opportunity is thus provided for a personal appeal to an impartial official with broad perspective who has ready access at all levels to those involved in a grievance. The ombud is always available to receive complaints, inquire into the matters involved, and mediate or otherwise resolve the problem. However, the ombud does not become involved with the normal operations of established procedures as outlined in the *Graduate Student Manual*, except where they are not functioning as intended.

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### Confidentiality of Student Records

Procedures for the release and disclosure of student records maintained by the University are in large measure governed by state and federal laws. Where the law is silent, the University is guided by the principle that the privacy of an individual is of great weight and that as much information in a student's files as possible should be disclosed to the student upon request. A current or former student has the right to inspect or review official records, files, and data directly related to that student. This right does not extend to applicants, those denied admission to the University, or those who were offered admission but did not enroll.

Some records not available to students are: letters of recommendation obtained or prepared before January 1, 1975; letters of recommendation that the student has waived his or her right to inspect; employment records of stu-

dents as University employees; clinical, medical, counseling, or psychiatric records; parents' financial aid records; and campus law enforcement records.

A student may challenge the factual and objective elements of the content of student records, but not the qualitative and subjective elements of grading. If the student objects to certain items included in his or her personal records, there is a grievance procedure that can be followed. Ultimately, a Hearing Board on Student Confidential Records could render a decision.

Third parties do not have access to personally identifiable records or information pertaining to a student without the written consent of the student who specifies that the records be released. Federal law requires that parents be considered third parties.

Detailed guidelines for the release and disclosure of information from student records are available from the Office of Student Life. They comply with the legal requirements of the Family Educational Rights and Privacy Act of 1974, as amended.

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### Notice of Change

Rules, regulations, dates, tuition, fees, the availability and titles of programs and areas of specialization, their administrative location, and courses set forth in this bulletin are subject to change without notice. Where a change in program requirements is made while a graduate student is currently enrolled, the student may elect to complete the program under the requirements in effect at the time of matriculation or to shift entirely to the new requirements, but may not choose parts of each set. As a result of the ongoing reviews of all graduate programs, certain offerings and specializations may be deleted or restructured between editions of the *Graduate Bulletin*.

# DEGREE REQUIREMENTS

**E**ach advanced degree awarded by the University requires as a minimum the successful completion of a specified number of approved credits of graduate study at the University and the passing of prescribed examinations. Credit hours for a master's or doctoral degree may include formal course work, independent study, research, preparation of a thesis or dissertation, and such other scholarly activities as are approved by the candidate's program committee and the Dean of the Graduate School.

*It is the student's responsibility to know the calendar, regulations, and pertinent procedures of the Graduate School and to meet its standards and requirements.*

These are set forth in this bulletin, the *Graduate Student Manual*, the *Statement on Thesis Preparation*, and other publications, all of which are available to graduate students at the Graduate School Office.

These documents govern both master's and doctoral degree programs. The manual gives detailed information on responsibilities of major professors and program committees, examination procedures, preparation of theses and dissertations, academic standards, and the Graduate Student Academic Appeals System.

The requirements immediately following are *general requirements* for all graduate students. *Specific requirements* for individual programs are itemized in the section "Graduate Programs."

## Program of Study

The purpose of the program of study is to ensure that students, at an early stage in their graduate study, organize coherent, individualized plans for their course work and research activities. It is expected that the successful completion of students' programs of study along

with collateral readings, research, etc., will enable them to demonstrate that they have achieved the high level of competence required of graduate students in their respective fields.

All degree candidates are required to prepare a program of study with the guidance of their major professors (for master's degree programs) or of their program committees (for doctoral programs) in accordance with the guidelines in the *Graduate Student Manual*. After the program has been approved by the major professor for master's degree candidates or by the program committee for doctoral candidates, the program of study is submitted for approval to the Dean of the Graduate School.

## Course Numbering System

All regular graduate courses are numbered at the 500 and 600 levels. All 900-level courses are special graduate



courses for which no graduate program credit is given. Courses numbered at the 400 level are for advanced undergraduates, but may, with approval and to a limited extent, be accepted toward meeting degree requirements at the master's level. For doctoral candidates who have completed the master's degree in the same field or one closely related, all program work must be at the 500 or 600 level.

## Scholastic Standing

Graduate work is evaluated by letter grades. All grades earned will remain on the student's record, and unless the courses were approved for no program credit prior to registration, all unacceptable grades will be included in calculating the student's scholastic average.

A grade of C+ (2.33) or lower in courses numbered below the 500 level is considered a failing grade. In such cases of failure the course must either be repeated, if it is a required course, or else replaced by another course approved by the candidate's program committee and the Dean of the Graduate School. When students receive more than one grade of C+ (2.33) or lower in courses below the 500 level, their graduate status is subject to review by the Dean of the Graduate School.

Grades of C-, D, and F are failing grades in courses at the 500 and 600 levels and require immediate review of the student's status. Students failing these courses must repeat them, if they are required courses, or else they must replace them with courses approved by the candidate's program committee and the Dean of the Graduate School.

The grades S (satisfactory) and U (unsatisfactory) are used for courses of study involving research undertaken for the thesis or dissertation and for certain courses and seminars so designated. The letter I (incomplete) is used for excused unfinished work. Incomplete grades assigned to graduate students may be removed within one calendar year. If the grade of I (incomplete) is not removed within one calendar year, it will remain on the transcript but may not be used for program credit. Grades of S, U, and I are not included in the academic average.

To qualify for continuation of degree candidate status and for graduation, a cumulative average of B (3.00 on a 4.00 scale) in all work is required, except for courses meeting entrance deficiencies or approved for no program credit prior to registration in the course. At any time when the academic record indicates unsatisfactory performance, the student's status is subject to review. A student who fails to maintain a satisfactory quality point average or to make acceptable progress toward the degree may be dismissed as a graduate student.

## Master's Degree Requirements

There are no major or minor area requirements for the master's degree. However, no degree can be awarded for the accumulation of credits without a planned and approved program of study. Courses for the degree are expected to be concentrated in the candidate's field of interest and related areas to produce a well-developed and coherent program.

Requirements for the master's degree must be completed within a period of four calendar years, or within a maximum of seven calendar years with special permission of the department and the Dean of the Graduate School if the study is done on a part-time basis. The master's degree may be earned through full- or part-time study, or a combination of the two. Candidates must take at least 80 percent of the credits required for the degree at the University of Rhode Island.

Some departments offer both a thesis and a nonthesis option, while others offer only one plan. Please refer to the "Graduate Programs" section for specific information on each program. The general requirements for these options are as follows.

**Thesis Option.** The minimum requirements for a master's degree are: 1) the successful completion of 30 credits, including 6 thesis research credits; 2) at the discretion of the department, the passing of written comprehensive examinations toward the end of the course work; 3) the submission of an acceptable thesis and the passing of an oral examination in defense of the thesis. Four copies of the thesis prepared in accordance with Graduate School requirements must be submitted

to the Graduate School Office. A statement on preparation of theses is available from that office.

**Nonthesis Option.** Depending on departmental requirements, some master's degrees may be earned without a thesis. The minimum requirements for a nonthesis master's degree program are: 1) the successful completion of a minimum of 30 credits; 2) registration in advanced seminars, practicums, internships, or other experiences useful to the student's future professional career; 3) registration in one course that requires a substantial paper involving significant independent study; 4) the passing of a written comprehensive examination toward the end of the course work. Some departments may also require a final oral examination.

**Research Competency.** Although not normally required for the master's degree, a student's major professor or thesis committee may require proficiency in a foreign language, statistics, or computer science where appropriate for the subject chosen.

## Professional Degree Requirements

Students should refer to the specific program requirements for professional degrees and consult with the appropriate dean or director.

## Doctor of Philosophy Degree Requirements

The Doctor of Philosophy degree must be completed within seven years of the date when the student first enrolled as a candidate.

The requirements for the doctoral degree are: 1) the completion of a minimum of 72 credits of graduate study beyond the baccalaureate degree, of which a minimum of 42 credits must be taken at the University of Rhode Island; 2) the passing of a qualifying examination; 3) if required by the department, proficiency in one or more foreign languages and/or in an approved research tool; 4) the passing of a comprehensive examination; 5) the completion of a satisfactory dissertation; 6) the passing of a final oral examination in defense of the dissertation; and 7) fulfillment of

the residence requirement of maintaining full-time residence for at least two consecutive semesters while acquiring the last 42 credits for the degree, but prior to taking the doctoral comprehensive examinations. Residence is interpreted as full-time attendance (nine credits or more) on campus or in the College of Continuing Education during a regularly scheduled semester. Full-time registration for both terms of a summer session counts as one semester of residence. With the exception of graduate assistants, instructors, research assistants, or the equivalent, no candidate for the doctorate may count part-time study toward satisfying this residence requirement unless a specific request for an exception, outlining the reasons and alternate method of satisfying the requirement, is approved by the candidate's doctoral committee and submitted together with the candidate's program of studies for the approval of the Dean of the Graduate School. The department in which the student studies for the doctoral degree may or may not require a master's degree preliminary to, or as part of, the regular course of study.

**Qualifying Examination.** This examination is intended to assess a student's potential to perform satisfactorily at the doctoral level. A student without a master's degree who is accepted as a doctoral candidate is expected to take a qualifying examination, usually after 24–30 credits have been completed. A student who holds a master's degree in the same or a closely related field is normally not required to take the examination. If an examination is required, it will be stipulated at the time of admission.

**Research Competency.** Each department, in cooperation with the Graduate School, is authorized to formulate and to amend its own requirements and methods of testing for competency in research tools such as foreign language(s), computer science, or statistics. The department may, in turn, delegate this responsibility to the program committee for each individual doctoral candidate.

**Comprehensive Examination.** Each doctoral candidate will take comprehensive examinations at or near but not later than 12 months after completion of the formal courses stipulated in

the program of study. The examination is designed to assess the student's intellectual capacity and adequacy of training for scholarly research.

The comprehensive examination consists of two parts: written and oral. The student, with the approval of his or her program committee, applies to the Graduate School to take the examination. The oral examination committee includes the student's committee and two additional members of the graduate faculty appointed by the Dean of the Graduate School. One of the additional members represents a field of study allied to that of the student's major. The candidate's major professor arranges for and chairs the examination. Unanimous approval by the examining committee is required for the passing of the comprehensive examination.

A candidate whose performance fails to receive unanimous approval of either examining committee may, with the committee's recommendation and the approval of the Dean of the Graduate School, be permitted one re-examination in the part or parts failed, to be taken no sooner than 10 weeks and no later than one year after the initial examinations.

**Final Oral Examination.** This examination is a defense of the dissertation and is open to all members of the faculty and, generally, to all students. The examination, usually two hours long, is conducted by an examining committee comprised of the candidate's program committee and two additional graduate faculty members appointed by the Dean of the Graduate School. One of the appointed members will be designated by the Dean to chair the examination.

Unanimous approval of the examining committee is required for passing. If the candidate does not perform satisfactorily, the committee may recommend to the Dean of the Graduate School that the candidate take one re-examination under stated conditions.

the Graduate School, is required. At least 20 calendar days prior to the proposed defense, the copies must be submitted to the Graduate School for scheduling of the examination.

Following a successful defense, and after all changes and corrections have been made, four copies prepared in accordance with requirements of the Graduate School and the Library must be submitted to the Graduate School Office. Doctoral candidates must submit an additional abstract, not exceeding 350 words.

Students are advised to consult the *Statement on Thesis Preparation and Instructions for Thesis Defense*, both available in the Graduate School Office, and the most recent edition of Kate L. Turabian's *A Manual for Writers of Term Papers, Theses, and Dissertations*, published by the University of Chicago Press.

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## Theses and Dissertations

For the oral defense, a sufficient number of completed copies of the thesis or dissertation, acceptable in form and substance to each member of the examining committee and the Dean of

# ADMISSION AND REGISTRATION

## Admission

**P**ersons holding the baccalaureate degree and wishing to take graduate-level courses at the University may do so through admission to the Graduate School as degree candidates, or through post-baccalaureate work in nonmatriculating status (see page 19). Admission to the Graduate School is based on academic qualifications and potential without regard to age, race, religion, sex, national origin, handicap, or sexual orientation, and discrimination against disabled and Vietnam era veterans.

A package of self-managed application materials can be obtained from the Graduate Admissions Office, University of Rhode Island, Quinn Hall, Kingston, RI 02881-0809. Zip code should be included in the applicant's return address. Inquiries concerning particular degree

programs or courses of instruction should be addressed to the appropriate department chairperson as listed in the "Graduate Programs" section of this bulletin.

The completed application package must be returned directly to the department or program to which admission is sought. Final decision on admission rests with the Dean of the Graduate School, who, after considering the recommendation of the department concerned, will notify the applicant of his decision.

Where admission to a doctoral program is possible for those holding the bachelor's degree and meeting other requirements, the Graduate School reserves the right to offer admission only to the master's program while postponing a decision on admission to the doctoral program until at least a

substantial portion of the master's work has been completed.

All applications must be accompanied by a nonrefundable application fee: \$30 for in-state and \$45 for out-of-state residents. Simultaneous application to more than one department requires duplicate applications and credentials and separate application fees.

The completed application package and all supporting documents must be received by April 15 for summer admission, July 15 for September admission, and November 15 for January admission. The application package must be received by February 1 for consideration for financial aid for the following year. As indicated in the "Graduate Programs" section in this bulletin, certain programs admit students only for September or they have earlier deadlines. There is no assurance



that applications completed after specified deadlines will be processed in time for enrollment in the desired semester. Admission is valid only for the term offered and must be reconsidered if a postponement is subsequently requested.

**International Applicants.** Applicants from foreign countries must complete the Test of English as a Foreign Language (TOEFL) with a minimum score of 550 unless a higher minimum is listed under the admission requirements for the specific program. Self-administered international application forms can be obtained from the Graduate Admissions Office. The completed application package must be returned directly to the department or program to which admission is sought. Inquiries from international students concerning nonimmigrant visas, transfers, funding, etc., should be sent to the Office of International Student Services. On- and off-campus housing inquiries should be sent to the University Housing Office.

**Transfer Credit.** Transfer credit can be requested for graduate work taken at other accredited institutions of higher learning. Such credits may not exceed 20 percent of the total credits required for the program. Doctoral candidates holding a master's degree in the same or a closely related area can request up to 30 credits. The transfer work must have been taken at the graduate level (equivalent to the 500 level or higher in the University of Rhode Island course-numbering system) and a passing grade earned at that institution. It must have been completed not more than five years prior to the date of request for transfer into a master's program (ten years for the doctoral program) and must have a clear and unquestioned relevance to the student's program of study. The request for transfer credit should be accompanied by a proposed program of study and must have the approval of the student's major professor and the Dean of the Graduate School. If transfer credit is desired for work taken elsewhere after a graduate student is enrolled at the University, *prior approval* must be obtained from the Dean of the Graduate School.

**Degree Candidates.** Applicants must forward directly to the department to which admission is being sought the completed self-managed application package, containing **all** of the requested

materials. Where required, test scores in the appropriate nationally administered tests should be sent directly to the department by the testing service. Tests required for specific programs can be found in the section "Graduate Programs." Scores (GRE, MAT, or GMAT) which were earned more than five years prior to the term of application will not be accepted. If test results exceed the five-year limit, applicants must retake the examination.

To be accepted as graduate degree candidates, applicants must have maintained an average of approximately B (3.00 on a 4.00 scale) or better in their undergraduate work. For programs that require standardized tests, students must also have satisfactory scores on the appropriate nationally administered test. Applicants with undergraduate averages below the B level may possibly be admitted with submission of other evidence of academic potential; i.e., satisfactory performance in postbaccalaureate work, professional experience as evidenced by publications or letters of recommendation, and/or high scores in the standardized tests referred to above. All students are expected to maintain a cumulative average of B (3.00) or better. Students who do not maintain a cumulative B average will have their status reviewed and may be placed on provisional status or be dismissed. A student placed on provisional status must achieve a cumulative B average within one semester (or nine credits, if part time) or be subject to suspension or dismissal.

**Advanced Standing.** A maximum of 12 credit hours of work taken at the University of Rhode Island in nonmatriculating status may be applied toward degree requirements if the student is later admitted to a degree program, but only with the recommendation of the student's program committee and the approval of the Dean of the Graduate School. Advanced standing for work taken at another institution must also be included within this limit. The request should be accompanied by a proposed program of study and satisfy the time constraints listed for transfer credit.

In certain cases, applicants who have been denied admission may be advised to take several courses in nonmatriculating status (see the following paragraph) to provide a basis for later reconsideration of their applications. In such cases, these courses are usually regarded

as though they were entrance deficiencies and are not accepted for advanced standing within minimum-credit programs of study.

**Nonmatriculating Status.** Individuals holding a bachelor's degree who are not candidates for an advanced degree may take courses during the academic year or in the summer in nonmatriculating status. Normally, to take courses for personal satisfaction or professional advancement, postbaccalaureate students enroll in the College of Continuing Education. Any nonmatriculating student wishing to take courses on the Kingston Campus must file an application with the Office of the Registrar. If nonmatriculating students later wish to be admitted to a degree program, they must complete the regular admission procedure.

Nonmatriculating students do not have the privileges regularly enjoyed by degree candidates. For example, on the Kingston Campus they may not register until one week before classes begin and must make payment before accessing the telephone registration system. Their enrollment is subject to the accommodation of degree candidates wishing to take these courses. In addition, there is a limit to the number of courses taken in this status that may be used as advanced standing to satisfy degree requirements. Nonmatriculated students are not eligible for financial aid.

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## Registration

The responsibility for being properly registered rests with the student. Students must complete their registration within the time period announced by the University. The chairperson of the student's major department will assign an advisor to assist the new graduate student in planning a program. All students must register for courses through the Office of the Registrar in order to be properly enrolled.

**Early Registration.** Matriculated (official degree-seeking) students who meet the eligibility requirements as defined in the *Schedule of Courses* generally register in March and October for the following semester. New and re-enrolling students will receive information concerning registration procedures. The *Schedule of Courses* is available at the Office of the Registrar.

**Late Registration.** Students are expected to register for courses before classes begin. Those who are unable to do so may enroll as late registrants in the Office of the Registrar during the first two weeks of classes. A late registration fee will be charged unless it is waived by the Office of the Registrar.

**Schedule of Courses.** The *Schedule of Courses* is published in March for the fall semester and in October for the spring semester. It is available in the Office of the Registrar. The University reserves the right to cancel courses offered in the *Schedule of Courses*.

**Payment of Fees.** Arrangements must be made with the Bursar for complete and timely payment of tuition and/or fees. If during the semester it becomes apparent that a student has not met his or her financial responsibilities to the University, registration for that semester is subject to immediate cancellation.

**Drop and Add.** Students are permitted to drop courses and add courses with subsequent reassessment of fees (see page 22) during the first two weeks of classes. The final day to drop courses without a grade is midsemester. However, fees are not reassessed for courses dropped after the second week of classes.

**Change of Address.** It is the responsibility of the student to complete a change of address form in the Office of the Registrar whenever a change is made in the local, campus, or mailing address.

**Summer Session.** Although some graduate-level courses are offered during the summer sessions, the University does not guarantee that any particular course will be offered. The availability of individual faculty members to supervise research or to participate in comprehensive examinations and in examinations in defense of theses or dissertations during the summer sessions varies from year to year. During the summer sessions, special arrangements must be made with both the Graduate School and the department for scheduling comprehensive examinations and thesis or dissertation defenses. Graduate students must make prior individual arrangements for taking directed studies or special problems courses.

**Time Limit and Continuous Registration.** Graduate students are expected to complete their course work and research within the four-year time limit prescribed for the master's degree and the seven-year time limit for the doctorate.

The time limit for a degree program may be extended by applying to the Dean of the Graduate School for legitimate reasons such as military service or serious illness. This request requires the endorsement of the student's major professor or department chairperson.

Graduate students must remain continuously enrolled, except for summer sessions, which are optional, until they have completed all requirements and have received their degree. Students who wish to maintain graduate status but are not registered for course work or research and are not on a leave of absence approved by the department and the Dean of the Graduate School must pay the continuous registration fee each semester until the degree has been awarded.

Students who are on a leave of absence or are signed up for continuous registration do not have the privileges of consulting regularly with faculty on research or thesis preparation nor of using laboratory, computer, or other educational facilities at the University.

A student who does not register for a semester, or obtain approval for a leave of absence, will be considered as having voluntarily withdrawn from the University. Students who are later permitted to re-enroll must pay the CRG fee for each semester in which they did not maintain graduate status.

**Full-Time and Part-Time Students.** The normal full-time registration is 12 credit hours of study during a regular semester. Minimum full-time registration is nine credit hours during a regular semester and six credit hours during a summer session. Maximum registration of 15 credit hours during a regular semester and eight credits during each summer term may not be exceeded without prior written permission of the Dean of the Graduate School, based on extraordinary circumstances. Credits in excess of 15 will be billed at the per-credit rate. Full-time registration is required of all international students and of all students holding fellowships, assistantships, full scholarships, and traineeships administered by the Uni-

versity. Students who do not meet the minimum full-time registration requirement are considered part-time students.

**Credits Earned Off Campus.** Students who wish to register for credits to be counted toward a degree, and who will be earning these credits through off-campus activities such as research or independent study at a national laboratory, are required to obtain prior approval from the Dean of the Graduate School and to have these activities listed as part of their programs of study.

**Intellectual Opportunity Plan (Pass-Fail Option).** To allow graduate students to venture into new areas of knowledge without fear that their scholastic average will suffer, the Graduate Council has approved the Intellectual Opportunity Plan. (Please note that courses below the 400 level are automatically excluded from the scholastic average.) To be eligible for this option, the student's major professor or advisor must certify that the course or courses are outside the student's major field of study, are not entrance deficiencies, and are not specific requirements of, but are relevant to, the student's program. A maximum of four credits may be taken by the master's degree candidate and a maximum of eight credits, including any taken as a master's candidate, by the doctoral candidate.

**Audit.** Courses may be audited with the approval of individual course instructors and by presenting an auditor's card obtained from the Office of the Registrar. An auditor receives no course grade; consequently, an audited course does not count as part of the student's course load for registration purposes, does not appear on the transcript, and cannot count as work taken toward completion of residence requirements. A student must be enrolled in at least one other course to be permitted to audit a course.

**Required Identification.** In order to obtain a University ID card and to be certified for employment, students must have in their possession a photo identification card, such as a driver's license, and a certified copy of their birth certificate. A valid passport will serve both of these purposes.

# FEES AND FINANCIAL AID

*Charges and fees set forth in this bulletin are subject to change without notice.*

**T**uition and fees for graduate students vary according to whether or not the student is a legal resident of the state of Rhode Island and whether the student is enrolled in full-time or part-time study. All charges are payable by the semester and are due and payable upon receipt of the bill or by the due date indicated on the bill.

The Dean of the Graduate School classifies each student admitted to the University as a resident or nonresident student on the basis of all relevant information available to him and in compliance with the stated policy of the Board of Governors for Higher Education. A Certificate of Residence is included in the self-managed application package. It must be filed by residents of Rhode Island and by New England Regional Students; failure to file the affidavit will result in automatic classification as an out-of-state student. Forms for reclassification as a Rhode Island resident student are available in the Graduate School Office. A student may appeal the decision to the Board of Residence Review.

**New England Regional Student Program.** Under the provisions of the New England Regional Student Program for graduate students administered by the New England Board of Higher Education, the University charges a regional student rate (150 percent of Rhode Island resident tuition) to residents of other New England states who are matriculated graduate students in certain programs. The specific program must be one that has been designated *not available* by the student's home-state institutions of higher education, and must have been declared open to regional students by the University of Rhode Island. Students must apply through the Graduate School and must file a Certificate of Residence signed by the clerk of the city or town where they claim legal residence. This form is included in the application package. Determination of regional status is made by the Graduate School, which will inform the applicant of the final decision.

If a student transfers to another program, the regional student status is automatically terminated. Where appropriate, the student may apply for regional student status in the new program.

Normally, these programs are listed in the New England Regional Student Program graduate-level booklet. In cases where an apparently similar program of study is available at both institutions involved, residents of another New England state must obtain certification from the Dean of the Graduate School of each of their home-state institutions to document that the program of study is not available within that state system. This certification will normally take the form of a statement by the chairperson of the relevant department and endorsed by the graduate dean. Inquiries and requests for further information can be directed to the Dean of the Graduate School at the University of Rhode Island or to the New England Board of Higher Education, 45 Temple Street, Boston, MA 02111.

**Rhode Island Interinstitutional Exchange.** Full-time students matriculated at one of the public institutions of higher education in Rhode Island may enroll for a maximum of seven credits of their full-time schedule per semester for study at one of the other public institutions at no additional expense. Each institution will determine and maintain the integrity of the degree to be awarded. Students will be subject to the course selection process applicable at the receiving institution. Summer session and continuing education registrants are not covered under this program. Students interested in this arrangement should contact the Office of the Registrar.

**New England Land-Grant Student Exchange Program.** In order to provide graduate students at the New England land-grant universities with expanded access to unique programs and faculty expertise, these institutions have agreed to encourage student exchanges on a short-term basis. Students with special academic interests may take advantage of the talent and resources available at the state universities of the region without becoming a degree candidate at another institution.

To participate in this program, students must: 1) identify at least one course or a combination of courses related to their area of academic interest which is not available on their home campus, or which is available but is taught with a significantly different viewpoint or methodology; 2) obtain approval from their appropriate academic advisor and the graduate program director; 3) receive permission from the university exchange authorities at both the sending and the receiving institutions; and 4) meet the minimum eligibility requirements. Graduate students must have been admitted to a degree program, be in good standing, and have the permission of their dean's office.

**Tuition Waiver for Senior Citizens.** Any Rhode Island resident senior citizen who submits evidence of being 60 years of age or over, and of having a household income of less than three times the federal property level, will be allowed to take courses at any public institution of higher education in the state with the tuition waived. However, students who qualify for waivers must apply for financial aid. Any aid received must be applied toward the amount waived. Admission into particular courses will be granted on a space-available basis and at the discretion of the receiving institution. All other costs of attendance are paid by the student.

**Tuition Waiver for Unemployed.** Any individual who submits evidence of currently receiving unemployment benefits from the state of Rhode Island, of having a household income of less than three times the federal property level, and of not being claimed as a dependent by a parent (or someone else) will be allowed to pursue course work at any public institution of higher education in Rhode Island with tuition and the registration fee waived. However, students who qualify for waivers must apply for financial aid. Any aid received must be applied toward the amount waived. Individual students will be responsible for all other costs of attendance. Admission into particular courses will be granted on a space-available basis and at the discretion of

the particular institution. This waiver also applies to any Rhode Island resident who submits evidence of residency and of currently receiving unemployment benefits in another state.

**Schedule of Fees.** This schedule of fees is effective for the 1993–94 academic year. The University reserves the right to revise its schedule of tuition and fees without notice.

#### *Full-Time, One Academic Year*

Students registered for 9–15 credits, graduate research assistants, and graduate assistants are considered full time and are charged the following fees:

#### **Tuition**

Rhode Island residents	\$3,154
Regional students	4,732
Out-of-state residents	7,296
Registration fee	40
Graduate student assessment	20
Memorial Union fee	138
Recreation fee	70
Health Services fee	368
Student Health Insurance	429

Credits in excess of 15 will be billed at the per-credit rate listed for part-time registration. Enrollment at Kingston and CCE locations is combined when determining these fees. Dropping overload credit after the end of the add period does not reduce term bills.

#### *Kingston and CCE Enrollment*

All students who are full time because of combined enrollment at both the College of Continuing Education and the Kingston Campus (nine credits and over) are assessed the following fees at the standard full time rate when enrolled in at least five credits on the Kingston Campus: Memorial Union fee, Student Activity fee, Student Health Insurance, and Health Services fee. Students enrolled for less than five credits at the Kingston Campus are charged the fees at the part-time rate. Dropping courses at either location after the end of the add period does not reduce term bills.

#### *Health Services Fees*

All full-time graduate students, all international students and their spouses, and all graduate assistants and graduate research assistants are required to participate in the University Health Services plan and accompanying Stu-

dent Health Insurance plan. With the exception of international students and their spouses, the Student Health Insurance plan may be waived if evidence of comparable coverage in another plan is provided and if the student completes, signs, and returns a waiver card to University Health Services prior to the end of the add period (the first two weeks of school). Unless the insurance is waived, the student will be billed. Waiver forms may be obtained directly from Health Services. Part-time students and spouses of students are eligible to participate in the health and insurance plans on an optional basis.

#### *Part-Time, One Semester*

Students registered for eight credits or less are charged the following fees. Students maintaining continuous enrollment and registered for no credit (CRG 999) are required to pay a fee of \$195 per semester.

#### **Tuition, per credit hour**

Rhode Island residents	\$175
Regional students	263
Out-of-state residents	405
Registration fee	20
Graduate student assessment	1
Memorial Union fee (per credit)	8

**Reassessment of Fees.** Students are allowed to drop and add credits during the first two weeks of each semester (add period). Fees are reassessed and adjusted according to the credit enrollment, and student status resulting from drop and add transactions are processed by the Office of the Registrar during the add period. Following the add period, term bills are only reassessed for students who add credits. The dropping of credits after the add period does not reduce term bills.

**Application Fee.** An application fee must accompany each application for admission: \$30 for in-state and \$45 for out-of-state residents. See page 18 for application procedures.

**Additional Fees.** Students may be asked to make key deposits and to cover laboratory and other incidental expenses for specific courses. Students taking performance courses in music are charged an additional applied music fee each semester of \$95 for MUS 050, \$190 for MUS 231, 241, 242, 251, 261, 451, 461, 551, and 561 to cover the private lessons associated with these courses.

Master's degree candidates must pay a thesis-binding fee of \$18, and doctoral candidates must pay dissertation-binding and microfilming fees of \$83. These fees are due before candidates submit their dissertations for approval by the Graduate School.

**Late Fees.** A late registration fee of \$20 during the first week of classes, and \$55 thereafter, is charged unless it is waived by the Office of the Registrar.

**Remission of Fees.** Tuition and the registration fee are paid from University or grant funds for holders of tuition scholarships, graduate assistantships, and graduate research assistantships (12 credits maximum per semester), and most fellowships. The students are required to pay all other fees including the Health Services and Student Health Insurance fees, Memorial Union fee, and the graduate student assessment. Tuition for students appointed to partial assistantships will be prorated for the period of the appointment. The student will be responsible for the remainder of the full-time tuition and fees. The same policy applies to assistantships terminated during the academic year.

**Refunds.** Refunds of payments made or credits against amounts due to the University will be made to students who officially withdraw or take a leave of absence from the University according to the following scale: first two weeks, 80 percent; third week, 60 percent; fourth week, 40 percent; fifth week, 20 percent; after five weeks, no refund. The attendance period in which withdrawal occurs is counted from the first day of classes and includes weekends and holidays. Coverage under the Student Health Insurance plan terminates when the student withdraws for any reason other than graduation or incapacitating disability. Students whose coverage has terminated for reason of withdrawal may request a pro rata refund of their premium from the insurance company. (For more information, contact URI Health Services.)

**Indebtedness to the University.** Failure to make full payment of all required fees or to resolve other debts to the University (for example, unreturned athletic equipment, overdue short-term or emergency loans, lost library books, debts to the Office of Residential Life for damages, and obligations required

by the University Student Conduct System) may result in denial of registration for the following semester and/or disenrollment. Appropriate University departments will provide the student with notice of the debt, reason for it, and a review, if requested. A student must fulfill all financial obligations to the University before receiving transcripts or a diploma.

**Transcripts.** Each student who graduates from the University is entitled to one official transcript without charge. Students can obtain a copy of their transcripts by submitting a written request to the Office of the Registrar. A \$4 fee is charged for each individual transcript request.

Transcripts will not be issued to students who have any unpaid financial obligation to the University.

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## Financial Aid

There are several forms of financial assistance available to graduate students. To be eligible for any form of assistance, the student must first be admitted as a degree candidate. Detailed information (stipends, allowances, tenure, etc.) on fellowships, scholarships, and assistantships is available from the Graduate School Office. Fellowships and scholarships are awarded by the Dean of the Graduate School to students selected from nominations submitted by department chairpersons. Students are advised to request nomination for these awards by the chairperson of the department in which they plan to study or in which they are currently enrolled at the University.

Graduate students on URI fellowships, scholarships, and assistantships are expected to be full-time students in good academic standing and are not eligible for additional employment unless written permission is received from the Dean of the Graduate School.

**Fellowships.** Fellowships are awarded to graduate students in recognition of their achievement and promise as scholars. They are intended to enable students to pursue graduate studies and research without rendering any service to the University. Graduate fellows are required to be full-time students and may not engage in additional remunerative work without the specific

advance approval of the Dean of the Graduate School.

*Patricia Roberts Harris Fellowships* are available to doctoral-level students in selected fields. Recipients are nominated by departments. *URI Diversity Graduate Fellowships* are awarded by the Dean of the Graduate School to students from minority and under-represented groups. *URI Foundation Minority Fellowships* are also available to students from minority and under-represented groups, with nominations usually made by departments to the Dean of the Graduate School.

*Special Fellowships* are supported by various industrial firms, private foundations, and individuals, and are usually restricted to students in particular areas of study and research. The stipends and supplemental allowances of these fellowships are not uniform.

URI Fellows receive a stipend of at least \$7,550 for the academic year and have tuition and the registration fee paid from University funds. URI Fellows are responsible for the remaining fees. Those wishing to be considered for fellowships must have their application file completed no later than February 1.

**Graduate Assistantships and Graduate Research Assistantships.** Assistantships are awarded to full-time graduate students to provide them with teaching and research training. Assistants may be required to provide service for up to 20 hours per week. Appointments are initiated by department chairpersons. To be eligible for such an appointment, students must first be admitted as degree candidates. Applications for assistantships should be completed by February 1. Appointments are announced in early April.

*Departmental Graduate Assistants* assist, under supervision, with instructional and/or research activities of a department. Not more than 10 hours per week will be in classroom contact. Graduate assistant stipends for the 1993-94 academic year range from \$7,550 to \$8,350, depending upon qualifications. In addition, tuition and the registration fee (12 credits maximum) are paid from University funds for each semester of the academic year of the appointment. The student is responsible for the remaining fees. Additional remuneration is given for appointments during the summer,

although this cannot be guaranteed. Stipends and tuition remissions for students appointed to partial assistantships will be prorated for the period of the appointment. The student will be responsible for the remainder of the full-time tuition and fees. The same policy applies to assistantships terminated during the academic year.

*Graduate School Graduate Assistantships* are available for entering graduate students from minority and under-represented groups. Two years in duration, these assistantships are awarded on merit and need by the Dean of the Graduate School, with assignment to an appropriate department for supervision of activities.

*Graduate Research Assistants* are assigned to individual research projects sponsored either by the University or by an outside agency. On supported research contracts and grants, the graduate research assistants are expected to devote 20 hours per week to research activities. For this they normally receive a stipend ranging from \$7,550 to \$8,350 for nine months. In addition, tuition (12 credits maximum) and the registration fee are paid in each semester of the academic year of the appointment. The student is responsible for the remaining fees. Additional remuneration is given for appointments during the summer months. Stipends and tuition remissions for students appointed to partial assistantships will be prorated for the period of the appointment. The student will be responsible for the remainder of the full-time tuition and fees. The same policy applies to assistantships terminated during the academic year.

*Tuition Scholarships*, which cover tuition and registration fee, are awarded by the Dean of the Graduate School from University funds. These scholarships are awarded to qualified students demonstrating financial need. Application forms are available in the Graduate School Office.

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## Other Sources of Aid

There are many additional sources of financial aid available to students who qualify: scholarships from private organizations, clubs, labor unions, fraternities, sororities, and businesses; Vocational Rehabilitation financial support and Veterans Administration benefits,

including survivor benefits. Students should apply directly to the source if they believe they qualify. Graduate students have access to a national computerized database of fellowships and other financial assistance opportunities available to students pursuing advanced degrees, completing dissertation research, or seeking postdoctoral positions.

In addition, limited amounts of aid from federal and state sources are available through the Student Financial Aid Office. This office distributes money from various sources to help students with financial need. Need is defined as the difference between what it costs to attend URI and what the student and family can contribute from their financial resources, including all other sources of assistance. The student is expected to earn a portion of these resources. Only citizens, nationals, or permanent residents who have been accepted and are matriculated as URI graduate students are eligible. Special students and students attending only during the summer sessions are ineligible. The national Free Application for Federal Student Aid should be submitted to Federal Student Aid Programs in Iowa after January 1, but prior to March 1. For further information or copies of the forms, contact the Student Financial Aid Office in Roosevelt Hall. Phone: 401-792-2314.

#### **Federal Aid. Federal Perkins Loan.**

Graduate students can borrow up to \$30,000, including any undergraduate loans. These loans have a simple interest rate of five percent annually. Interest does not accrue until six months after graduation or withdrawal. Minimum payments of \$30 per month are required, and the repayment period may extend up to 10 years.

**Federal Work-Study Program.** This federally supported program provides part-time employment during the school term and full-time employment during the vacation periods. The jobs may be either with University departments or with off-campus, nonprofit, nonsectarian, nonpolitical agencies. Other institutionally funded employment is also available. A list of these jobs is available in the Student Financial Aid Office.

**Federal Stafford Loan Program.** All students who complete the Free Application for Federal Student Aid can participate in the Stafford Loan Program. Those students who meet the financial

need criteria may receive in whole or in part a subsidized loan where the federal government pays all interest until six months after graduation, withdrawal, or a drop in enrollment status to less than half time. Unsubsidized loans are available for those students who do not qualify for the need-based subsidized Stafford loan. The same terms and conditions as for subsidized Stafford loans apply, except that the borrower is responsible for the interest that accrues while in school. For new borrowers who receive loans, the interest rate is variable, with a nine percent maximum rate.

Eligible graduate students can borrow up to \$8,500 a year. The maximum total Stafford loan debt for graduate or professional study is \$65,000, including any loans made at the undergraduate level.

**Supplemental Loans for Students (SLS).** Graduate students can apply for loans of up to \$10,000 per year. A variable interest rate is calculated annually based on a federal formula. The new rate is set every year but cannot exceed 12 percent. Additional information is available from local lending institutions.

**University Aid. Regular Student Employment.** Positions funded by the University are available to several hundred students, and are listed in the Student Financial Aid Office.

**University Loans.** Emergency loans ranging from \$10 to \$200 are available to full-time students. These loans are short-term in nature (14–90 days) and can be made only when there is a means of repayment. Application forms are available in the Student Financial Aid Office.

**Veterans' Benefits.** Information can be obtained from the veterans' liaison officer in the Office of the Registrar. All students receiving veterans' benefits are required to report to the veterans' liaison officer when withdrawing from or dropping any course, or when withdrawing from the University. Failure to do so will result in the termination of veterans' benefits.

## **Special Awards**

**Ward Abusamra Scholarship in Music and Voice.** Income from endowment for a scholarship in music awarded annually to a graduate or undergraduate music major on the basis of merit. Preference

given to students concentrating in voice or choral. Recipient to be selected by Department of Music Recruitment and Awards Committee during annual spring auditions.

**Stanley Berger Memorial Scholarship.** Income from endowment to be awarded annually to a graduate student in clinical psychology. Recipient selected by the Department of Psychology.

**Bertran M. Brown '36 Endowment.** Income from endowment used for graduate student support in the Department of Chemistry.

**James Corless Prize in Marine Chemistry.** Income from endowment for an award in water chemistry given annually if there is a worthy student.

**Catharine and Walter Eckman Memorial Scholarship.** Income from endowment awarded to a graduate student in the humanities, including English, comparative literature, languages, history, philosophy, music, and political science. Recipients selected by Graduate School Committee on Scholarships and Fellowships.

**Farmer Family Trust—The Pacifico A. Colicci Award in Oceanography Engineering.** Award made each year at graduation to a student at the Graduate School of Oceanography who demonstrates exceptional vision and creativity in fashioning instruments for use in oceanography research.

**Farmer Family Trust—The Henry S. Farmer Award in Biological Oceanography.** Award made each year to a student in biological oceanography who demonstrates exceptional creativity and interest in preserving and developing the oceans as a biological resource.

**Robert H. '35 and Marjorie P. '36 Fillmore Memorial Scholarship.** Income from endowment fund, established by Judith A. Fillmore in memory of her mother and father, awarded to an undergraduate or graduate student on the basis of good scholastic standing who demonstrates financial need and is enrolled in a URI ocean sciences program. First consideration is given to sons and daughters of the URI Washington Alumni Club, Washington, D.C.

**John J. Fisher Memorial Endowment Award.** Income from endowment for an annual award in geology to a graduate assistant on the basis of service to the Department of Geology and a strong academic record.

*Graduate Library School Scholarship.* Income from endowment awarded annually to a student enrolled in the Graduate Library and Information Studies program.

*Graduate School of Oceanography Alumni Endowment.* Income from endowment for awards to deserving GSO students selected by the GSO Alumni Committee.

*Gray Family Endowment.* Income from endowment for a scholarship to a graduate student in the Department of Chemical Engineering doing research in the field of efficient supply and use of energy. Recipient selected by the College of Engineering.

*Arthur D. Jeffrey Memorial Scholarship.* Income from endowment for a scholarship awarded to a graduate student in community planning on the basis of financial need.

*Joshua MacMillan Graduate Fellowship in Fisheries Oceanography.* Income from the Davis Family Endowment awarded annually on the basis of financial need to a master's or doctoral student with marked interest in fisheries science.

*Thomas and Kathy McNiff Graduate Student Endowment.* Income from endowment awarded annually to a student in the marine sciences. Recipient selected by the Student Financial Aid Office.

*L. Douglas Nolan '52 Academic Achievement in Science Award.* This endowed award was established by L. Douglas Nolan for significant graduate student achievement in natural, physical, biological, agricultural, oceanographic, veterinary, or medical sciences. The recipient of this award is selected annually by the Dean of the Graduate School based on nominations submitted by department chairpersons. The criteria for selection are given in the call for nominations. This award recognizes superior academic performance and research accomplishments during the course of graduate study. It includes a financial award of \$500.

*Nancy Potter Endowment.* Income from endowment for a prize in poetry for graduate and undergraduate students. The awards will be made through the Academy of American Poets. Recipients will be selected from a competition held each spring semester.

*William Potter Chemistry Award.* Income from endowment for an annual award to doctoral students in pharmacy on the

basis of academic achievement in chemistry. The recipient is selected by a College of Pharmacy committee.

*Dr. and Mrs. James P. Reid Endowed Scholarship.* This scholarship is awarded to a graduate student with high academic standing enrolled in the master's degree program in physical education. The recipient will be selected by the Reid Scholarship Committee.

*Lance A. Ricci Fellowship.* Income from endowment awarded annually to a financially deserving GSO graduate student. Recipients selected by the Graduate School and Graduate School of Oceanography.

*Ada L. Sawyer Endowment for Oceanography.* Income from endowment awarded annually to an M.A. or Ph.D. student on basis of financial need and/or merit. Recipient must be born in the United States and in good standing with the University. Preference given to a woman demonstrating the spirit and ingenuity of Ada L. Sawyer.

*URI Class of 1933 Fellowship.* Income from endowment for a graduate fellowship.

*URI Foundation Endowment.* Income from endowment for a graduate student fellowship. Recipient selected by the Dean of the Graduate School from University-wide recommendations.

*Milton Waltcher '41 Memorial Endowment.* Income from endowment for annual awards to go to a deserving chemistry graduate student during summer months.

*Germaine and Francis Webb Graduate Fellowship in Oceanography.* Income from endowment awarded annually to a student from the Graduate School of Oceanography based on genuine financial need and research related to relevant marine environmental issues. The recipient is selected by the Dean of the Graduate School of Oceanography.

or she is pursuing according to the standards and practices of that institution."

To maintain satisfactory progress as a graduate student at the University of Rhode Island for federal financial aid purposes, the student must be enrolled in a degree-granting program on at least a half-time basis (i.e., five credits) for each semester during which aid is received. The courses must be graduate level and applicable to the student's approved program of study. Master's degree candidates have eight semesters to complete degree requirements on a full- or part-time basis. Students who are not in residence during the academic-year terms and who have received special permission from the Dean of the Graduate School have 14 summer sessions in which to complete requirements. Two summer sessions totaling at least five credits will be considered one part-time semester; two summer sessions totaling nine credits will be considered one full-time semester. Doctoral degree candidates have 14 semesters in which to complete their degrees, regardless of whether they matriculate with an earned master's degree.

Master's and doctoral students who have completed all course requirements including thesis research shall be considered to be making satisfactory progress at least at the half-time rate if they are registered for at least one thesis credit or continuous registration. All students must be enrolled for consecutive semesters until graduation unless an official leave of absence or interruption of study has been approved. If students exercise neither the leave of absence nor interruption of study option and fail to register, they are considered to have voluntarily withdrawn.

For further information, see the *Graduate Manual* or consult the Student Financial Aid Office. Phone: 401-792-2314.

## Policy on Satisfactory Academic Progress

The Education Amendments of 1980, P.L. 96-374, October 3, 1980, state that "a student is eligible to receive funds from federal student financial aid programs at an institution of higher education if the student is maintaining satisfactory progress in the course of study he

# GRADUATE PROGRAMS

**T**his section must be read in conjunction with the preceding "Degree Requirements" and "Admission and Registration" sections. The specific admission and program requirements listed in this section are included within the general requirements set forth in the preceding sections, and do not reduce those general requirements. For example, in nonthesis master's degree programs, all students must take at least one course that requires a substantial paper involving significant independent study. All Ph.D. candidates who do not hold an earned master's degree in a closely related field are required to take the Ph.D. qualifying examination even if it is not listed in the individual program requirements.

The admission requirement of standardized test scores (GRE, GMAT, MAT) is specific to the particular program. For programs that require a standardized test, applications will not be reviewed until the

scores have been received. In all other cases, scores may be submitted if applicants believe the test results will enhance their application. However, the test results should be submitted as early as possible. If an application is complete before the test results are received, the admission decision may be made without the scores.

Please note that the specific program requirements given on the following pages are minimum requirements. For example, additional course credits may be required for individual candidates whose academic background is considered to be insufficient. All graduate-level courses are also described in this chapter. Undergraduate courses numbered at the 400 level, permitted for graduate credit in some cases, are described in the *Undergraduate Bulletin* and are listed here for reference only. Courses at the 500 level must comprise the majority of course work between the bachelor's and the master's degrees. Those at the 600 level

are advanced graduate courses. The 900-level courses are special types of graduate courses for which no degree credit is given. They include courses offered to remedy deficiencies as well as workshops, institutes, and courses offered one time only by visiting faculty.

Courses with two numbers, e.g., ASP 501, 502, indicate a year's sequence, and the first course is either a prerequisite for the second or at least the two cannot be taken in reverse order without special permission. Parentheses after a course number enclose either the old course number or, in cases of multiple listings, the departments and numbers under which the course is also offered.

The roman numeral indicates the semester the course will normally be offered; some courses, however, are offered only in alternate years and a few less frequently. The *Schedule of Courses* issued by the Office of the Registrar during the October and March registration



periods must therefore be consulted to determine which courses will be offered in the following semester. The arabic numeral indicates the credits; distribution of class hours each week is in parentheses. The instructor's name follows the course description.

*The availability of programs of study and areas of specialization listed in this section, and their administrative location, requirements, and titles, are subject to change without notice.*

Students who are interested in the career opportunities related to particular programs of study are encouraged to discuss their interests with the appropriate department chairperson or with the director of graduate studies as listed in this bulletin, with the Dean of the Graduate School, or with the staff of the Office of Career Services. Students who are uncertain about their career choice are invited to use the services offered by the Counseling Center.

Successful completion of any course of study at the University, however, does not guarantee that the student will find either a specific kind or level of employment.

## Accounting

M.S.  
401-792-2073

### Graduate Faculty

*Chairperson:* Professor Spencer J. Martin, Ph.D., 1970, University of Illinois; C.P.A.

*Director of Graduate Studies:* Professor Henry R. Schwarzbach, D.B.A., 1976, University of Colorado; C.P.A.

Professor Joseph P. Matoney, Jr., Ph.D., 1973, Pennsylvania State University; C.P.A.

Professor Richard Vangermeersch, Ph.D., 1970, University of Florida; C.P.A., C.M.A.

Associate Professor Marshall A. Geiger, Ph.D., 1988, Pennsylvania State University; C.P.A.

Associate Professor Charles Hickox, J.D., 1979, Washington University

Associate Professor Mark Higgins, Ph.D., 1989, University of Tennessee; C.P.A.

Assistant Professor Judy K. Beckman, Ph.D., 1991, Texas Tech University; C.P.A.

Assistant Professor Edmund J. Boyle, Ph.D., 1990, Pennsylvania State University; C.P.A.

Assistant Professor Alejandro Hazera, D.B.A., 1989, University of Kentucky; C.P.A.  
Assistant Professor Jeffrey W. Power, Ph.D., 1991, Purdue University; C.M.A.

### Master of Science

The Master of Science in accounting program is appropriate for students with a variety of educational backgrounds and professional interests. The program has the objective of providing an accounting and business foundation for the student with an undergraduate degree in an area other than accounting. These students graduate with a strong theoretical understanding of accounting along with the necessary technical background. They are equipped to perform exceedingly well in entry-level positions in accounting. The objective for students with undergraduate degrees in accounting is to provide a fifth year of conceptual, theoretical, and technical education in accounting, finance, management science, and other areas where the student and program director feel the student can gain the most toward achieving his or her educational objectives.

Applicants with a bachelor's degree in accounting from an accredited institution can complete the program of study in one

### Course Codes

ACC Accounting  
ADE Adult and Extension Education  
AAF African and Afro-American Studies  
AVS Animal and Veterinary Science  
APG Anthropology  
AMS Applied Mathematical Sciences  
ASP Aquacultural Science and Pathology  
ART Art  
ARH Art History  
AST Astronomy  
BCP Biochemistry and Biophysics  
BOT Botany  
BUS Business Administration  
BSL Business Law  
CHE Chemical Engineering  
CHM Chemistry  
CVE Civil and Environmental Engineering  
COM Communication Studies  
CMD Communicative Disorders  
CPL Community Planning  
CLS Comparative Literature Studies  
CSC Computer Science  
CNS Consumer Studies  
DHY Dental Hygiene  
ECN Economics  
EDC Education  
ELE Electrical Engineering  
ENG English  
ENT Entomology  
EST Experimental Statistics

FIN Finance  
FST Fisheries Science and Technology  
FSN Food Science and Nutrition  
FRN French  
GEL Geology  
GER German  
GRK Greek  
HIS History  
HED Home Economics Education  
HDF Human Development and Family Studies  
HSS Human Science and Services  
IME Industrial and Manufacturing Engineering  
INS Insurance  
ITL Italian  
JOR Journalism  
LRS Labor and Industrial Relations  
LAR Landscape Architecture  
LAT Latin  
LSC Library and Information Studies  
LIN Linguistics  
MGT Management  
MIS Management Information Systems  
MGS Management Science  
MAF Marine Affairs  
MKT Marketing  
MTH Mathematics  
MCE Mechanical Engineering and Applied Mechanics  
MTC Medical Technology  
MCH Medicinal Chemistry  
MIC Microbiology

MUS Music  
NRS Natural Resources Science  
NES New England Studies  
NUR Nursing  
OCE Ocean Engineering  
OCG Oceanography  
OMT Operations Management  
PCG Pharmacognosy  
PCL Pharmacology and Toxicology  
PHC Pharmaceuticals  
PHP Pharmacy Practice  
PHL Philosophy  
PED Physical Education  
PHT Physical Therapy  
PHY Physics  
PLS Plant Sciences  
PSC Political Science  
PSY Psychology  
QBA Quantitative Business Analysis  
RCR Recreation  
RDE Resource Development Education  
REN Resource Economics  
RUS Russian  
SOC Sociology  
SPA Spanish  
TMD Textiles, Fashion Merchandising, and Design  
THE Theatre  
URB Urban Affairs  
WMS Women's Studies  
WRT Writing  
ZOO Zoology

year. Applicants with no prior education in business will need to spend two years in full-time study or longer if studying part time. The course of study is divided into two parts. Part one is a common body of knowledge in business and accounting that is required for all students without a bachelor's degree in business. The student's undergraduate record is evaluated, and common body of knowledge courses are waived when a student has undergraduate equivalents. The second phase of the program allows the students to build on their accounting foundation and develop a high level of theoretical knowledge and a sound understanding of accounting principles and techniques. During the second part of the program the student selects an area in which to specialize. Two areas are available:

- 1) financial reporting and auditing and 2) taxation.

**Admission requirements:** undergraduate quality point average of approximately B or above and a score at the 50th percentile or above on the GMAT Examination are expected. The GMAT score and the undergraduate quality point average are not the sole criteria for admission. However, those with undergraduate quality point averages of less than B or with lower than 50th percentile scores on the GMAT have a reduced probability of admission. Applicants for whom English is not the native language will be expected to demonstrate proficiency in written and oral communications (TOEFL score of 575 or above), or they may be required to correct deficiencies by taking selected courses for no program credit.

**Program requirements:** from 30 to 69 credits, depending on undergraduate program. A written comprehensive examination and a course requiring a major paper involving independent study are required in the nonthesis option.

All 500- and 600-level courses offered by the departments in the College of Business Administration are open to matriculated graduate students only.

## ACC Courses Accounting

**413 Contemporary Accounting Issues** (II, 3)

**415 Accounting Computer Systems** (I and II, 3)

**431 Advanced Accounting** (I, 3)

**443 Federal Tax Accounting** (II, 3)

**461 Auditing** (I, 3)

**535 Advanced Problems in Accounting** (II, 3) General and specialized accounting problems that constitute the subject matter of C.P.A. examinations. (Lec. 3) Pre: 431. Staff

**544 Taxation of Corporations and Shareholders** (II, 3) Examination of the tax laws affecting corporations and shareholders. Includes law governing corporate forma-

tion, liquidating and nonliquidating distributions, reorganizations, taxes on corporation accumulations, and planning of transactions for tax compliance and minimization. (Lec. 3) Pre: 443 or permission of instructor. Matoney

**562 Advanced Auditing** (II, 3) Statements on auditing standards, auditing electronic systems, auditor's reports, statistical sampling in auditing, regulations of SEC, and cases in auditing. (Lec. 3) Pre: 461. Boyle

**610 Financial Accounting** (I and II, 4) Covers basic accounting principles, accounting systems design, and financial statement analysis. Includes principles of responsibility accounting and budgeting. (Lec. 4) Pre: mathematics or statistics, ECN 590, MGS 520 and 530. Staff

**611 Managerial Accounting** (I or II, 3) Determination of accounting information for the purposes of decision making, control, and evaluation with emphasis on decision models using accounting information. (Lec. 3) Pre: 610, MGS 520 and 530. Staff

**618 Current Accounting Theory** (I, 3) Critical examination of accounting theory and practice to develop research techniques with emphasis on financial accounting. (Lec. 3) Pre: 311 and 312. Staff

**619 Current Accounting Theory** (II, 3) Critical examination of accounting theory and practice with respect to cost and managerial accounting. (Lec. 3) Pre: 321. Staff

**631 International Accounting** (II, 3) Covers interpretation of international financial statements, focusing on foreign currency exchange, comparative accounting principles and disclosures, and audit reports. Uses actual financial statements in case analyses. (Lec. 3) Pre: 610 or permission of instructor. Staff

**641 Federal Taxation Seminar** (II, 3) Examination and discussion of the laws and rationale affecting the federal taxation of individuals as well as an introduction to research in taxation. (Lec. 3) Pre: 311 and graduate standing in accounting. Staff

**643 Federal Taxes and Business Decisions** (II, 3) The course focuses on tax law and its effect on business decisions. Cases are employed and primary emphasis is on income tax planning, although estate and gift taxes are explored. Pre: 610. Staff

**644 Partnership, Estate, and Gift Taxation** (II, 3) Examination of the tax laws affecting partnerships, estates, and gifts. Includes income and wealth taxation with an emphasis on tax avoidance through effective planning. (Lec. 3) Pre: 641. Matoney

**645 Advanced Topics in Federal Taxation** (II, 3) Examination of tax laws governing sales and exchanges, accounting methods, accounting changes, deferred compensation, tax shelters, and recent developments in the tax laws. (Lec. 3) Pre: 443 or 641. Matoney

**646 Seminar in Tax Research, Policy, and Planning** (I, 3) Examination of the methodology of tax research, the principles and procedures involved in tax planning, and the procedures involved in dealing with the IRS. (Sem. 3) Pre: 641 or equivalent. Matoney

**661 Seminar in Auditing** (I, 3) Readings and discussions on auditing standards, procedures, programs, working papers, internal control, and current auditing topics. (Lec. 3) Pre: 311 and graduate standing in accounting. Staff

**681 Accounting Policy** (II, 3) Development of accounting policy with respect to managerial planning and control. Emphasis on analytical evaluation of cases with major research project. (Lec. 3) Pre: 618, graduate standing, and completion of all foundation courses. Staff

**691, 692 Directed Study in Accounting** (I and II, 1-3 each) Advanced work under the supervision of a staff member and arranged to suit the individual requirements of the student. (Lec. 1-3) Pre: permission of instructor. Staff

**693 Internship in Accounting** (I and II, 3) Participation in management and/or problem solving under the supervision and guidance of a sponsoring agency with evaluation by the College of Business Administration. Pre: proposal acceptance by the College of Business Administration, no previous internship credit, graduate standing. S/U credit. Staff

**697 Doctoral Research Seminar** (I and II, 3) Provides a rigorous analysis of current research questions and research techniques used to address those questions in the academic discipline. Recent developments and current issues addressed. Pre: enrollment in Phase II of the Ph.D. program in business administration. Staff

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## Animal and Veterinary Science

See Fisheries, Animal and Veterinary Science on page 55.

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## Applied Mathematical Sciences

Ph.D. (Interdepartmental)  
401-792-5592

This interdepartmental program is sponsored by the Departments of Computer Science and Statistics, Industrial and Manufacturing Engineering, Management Science and Information Systems, and Mathematics. It is administered by a coordinating committee selected from the graduate faculty.

**Coordinating Committee:** Gerasimos Ladas (chairperson), Gérard M. Baudet, David L. Freeman, Leonard M. Kahn, W. Dennis Lawing, Seetharama Narasimhan

**Graduate Faculty**

Professor Edward J. Carney, Ph.D., 1967, Iowa State University  
 Professor Rodney D. Driver, Ph.D., 1960, University of Minnesota  
 Professor Edward A. Grove, Ph.D., 1969, Brown University  
 Professor R. Choudary Hanumara, Ph.D., 1968, Florida State University  
 Professor James F. Heltshe, Ph.D., 1973, Kansas State University  
 Professor Jeffrey E. Jarrett, Ph.D., 1967, New York University  
 Professor Russell C. Koza, Ph.D., 1968, Rensselaer Polytechnic Institute  
 Professor Gerasimos Ladas, Ph.D., 1968, New York University  
 Professor James T. Lewis, Ph.D., 1969, Brown University  
 Professor Pan-Tai Liu, Ph.D., 1968, State University of New York, Stony Brook  
 Professor Dennis W. McLeavey, D.B.A., 1972, Indiana University; C.P.I.M. (Fellow); C.F.A., 1990  
 Professor Richard Mojena, Ph.D., 1971, University of Cincinnati  
 Professor Seetharama Narasimhan, Ph.D., 1973, Ohio State University  
 Professor Lewis J. Pakula, Ph.D., 1972, Massachusetts Institute of Technology  
 Professor S. Ghon Rhee, Ph.D., 1978, Ohio State University  
 Professor Oved Shisha, Ph.D., 1958, Hebrew University  
 Professor Robert C. Sine, Ph.D., 1962, University of Illinois  
 Professor E. Ramnath Suryanarayan, Ph.D., 1961, University of Michigan  
 Professor Donald W. Tufts, Sc.D., 1960, Massachusetts Institute of Technology  
 Professor Ghasi Ram Verma, Ph.D., 1957, Rajasthan University  
 Associate Professor Gerard M. Baudet, Ph.D., 1978, Carnegie Mellon University  
 Associate Professor Frank M. Carrano, Ph.D., 1969, Syracuse University  
 Associate Professor Norman J. Finizio, Ph.D., 1972, Courant Institute of Mathematical Sciences, New York University  
 Associate Professor James G. Kowalski, Ph.D., 1975, University of Notre Dame  
 Associate Professor Edmund A. Lamagna, Ph.D., 1975, Brown University  
 Associate Professor William D. Lawing, Jr., Ph.D., 1965, Iowa State University  
 Associate Professor Bala Ravikumar, Ph.D., 1987, University of Minnesota  
 Associate Professor David M. Shao, Ph.D., 1970, State University of New York, Buffalo  
 Assistant Professor Joan Peckham, Ph.D., 1990, University of Connecticut  
 Assistant Professor Catherine Roberts, Ph.D., 1992, Northwestern University  
 Assistant Professor Victor Wolfe, Ph.D., 1991, University of Pennsylvania

Professor Emeritus Emilio O. Roxin, Ph.D., 1959, University of Buenos Aires

**Specializations**

Applied mathematics, computer science, operations research, statistics, and applied probability.

**Doctor of Philosophy**

*Admission requirements:* GRE with advanced test in undergraduate field, bachelor's degree in computer science, engineering, mathematics, management science, physical sciences, statistics, or equivalent. With permission, GMAT may be substituted for GRE by applicants with business background. Applicants with entrance deficiencies may be accepted subject to taking certain undergraduate courses in addition to the graduate program requirements. Although a person with a bachelor's degree may be admitted, this program is designed principally for people who have a master's degree.

*Program requirements:* dissertation, 54 credits beyond the bachelor's degree including MTH 435, 436, two courses selected from MTH 462, 513, 515, 535, 545, 561, and 641, and three core courses in each of two of the following areas: applied mathematics, basic analysis, numerical analysis, computer science, operations research, statistics, and applied probability. (A maximum of 30 credits may be granted for a master's degree in a closely related area.) Comprehensive examination in core areas and reading proficiency in one foreign language. The Ph.D. qualifying examination is required of students admitted without the master's degree. All Ph.D. candidates must register full time for two consecutive semesters prior to the Ph.D. comprehensive examination.

**AMS Courses****Applied Mathematical Sciences**

**699 Doctoral Dissertation Research (I and II)** Number of credits is determined each semester in consultation with the major professor or program committee. *S/U credit.*

**Aquacultural Science and Pathology**

See Fisheries, Animal and Veterinary Science on page 55.

**Audiology**

M.A., M.S.

See Speech-Language Pathology on page 103.

**Biochemistry and Biophysics**

M.S., Ph.D. (Biological Sciences)  
 401-792-2201

**Graduate Faculty**

*Chairperson:* Professor George C. Tremblay, Ph.D., 1965, St. Louis University  
*Director of Graduate Studies:* Professor Karl A. Hartman, Jr., Ph.D., 1962, Massachusetts Institute of Technology  
 Associate Professor John R. Babson, Ph.D., 1980, Oregon State University  
 Associate Professor Terence M. Bradley, Ph.D., 1983, University of Idaho  
 Associate Professor Dennis E. Rhoads, Ph.D., 1982, University of Cincinnati  
 Assistant Professor Joel M. Chandless, Ph.D., 1984, North Carolina State University  
 Assistant Professor Joanna H. Norris, Ph.D., 1982, Michigan State University

**Specializations**

Neurochemistry of alcoholism, olfactory signal transduction; structure and function of receptors, protein phosphorylation, spectroscopic studies of the structures of nucleic acids and proteins, metabolism of nitrogenous constituents in mammalian tissues, regulation of metabolism, biochemical, molecular, and genetic analysis of plant mutants, biochemistry of salmonid parr-smolt transformation, synthesis of hepatic proteins.

**Master of Science**

*Admission requirements:* GRE and a bachelor's degree in some field of science or engineering including two semesters each in organic chemistry with laboratory, biological sciences, and calculus, and one semester in physics. Students may be accepted with deficiencies, which must be made up without program credit.

*Program requirements for all M.S. candidates:* BCP 435, 521, 541, 581, 582, one credit of 695 or 696, and three credits in an additional 500-level course exclusive of special topics or research. All full-time students are expected to be continuously registered for BCP 695, 696 (Seminar), but no more than one credit can be used for program credit. Thesis option: a minimum of 24 credits (exclusive of thesis credits) including the above requirements and a thesis. Nonthesis option: a minimum of 36 credits including the above requirements, BCP 651 or 652, and the written master's examination.

**Doctor of Philosophy (Biological Sciences)**

*Admission requirements:* same as for master's degree candidates; M.S. degree not required to enroll in Ph.D. program. Qualifying examination required of all Ph.D. candidates.

*Program requirements:* BCP 435, 521, 541, 581, 582, a total of three credits in BCP 695, 696, at least six credits of additional BCP course work at the 500 level exclusive of special topics or research, comprehensive examination, and dissertation. All full-time students are expected to be continuously registered for BCP 695, 696 (Seminar), but no more than three credits can be used for program credit.

## BCP Courses Biochemistry and Biophysics

**401 (or MIC 401) Quantitative Cell Culture (I, 3)**

**403 (or MIC 403) Introduction to Electron Microscopy (I, 2)**

**405 (or MIC 405) Electron Microscopy Laboratory (I, 2)**

**412 Biochemistry Laboratory (II, 3)**

**421 (or MIC 421) Cell Biology and Cancer (I, 3)**

**435 Physical Chemistry for Life Sciences (I, 3)**

**491, 492 Research in Biochemistry and Biophysics (I and II, 1–6 each)**

**503 Electron Microscopy**  
See Microbiology 503.

**505 Laboratory in Electron Microscopy**  
See Microbiology 505.

**521 Physical Biochemistry (I, 3)** The use of diffusion, sedimentation, viscosity, electrophoresis, isoelectric focusing, chromatography, and spectroscopy, (including linear and circular dichroism) to determine the size, shape, structure, interactions, and molecular weight of biological macromolecules. (Lec. 3) *Pre:* 435 or equivalent. *In alternate years. Next offered fall 1995.* Hartman

**523, 524 Special Topics in Biochemistry and Biophysics (I and II, 1–3 each)** Advanced work arranged to suit the individual needs of the student. Lecture and/or laboratory according to the nature of the problem. *Pre:* permission of chairperson. *May be repeated for a maximum of 12 credits.* S/U credit for 524. Staff

**541 Laboratory Techniques in Biochemistry (I, 3)** Potentiometric titration and buffers, spectroscopy (UV, visible, and IR), protein assays, radioisotopes, gel electrophoresis, chromatography (thin-layer, ion-exchange, and high-performance), and ultracentrifugation. *Pre:* general chemistry, organic chemistry, and credit or concurrent enrollment in at least one semester of biochemistry. Hartman

**542 Proteins: Purification and Characterization (II, 3)** Use of techniques for protein purification and activity studies. Laboratories involve enzymology, chromatography, investigation of soluble and membrane-bound receptors, gel electrophoresis and silver staining, thin-layer electrophoresis and autoradiography. (Lec. 1, Lab. 6) *Pre:* 311 or 581 and permission of instructor. Rhoads

**551 (or MTC 551) Topics in Biochemistry for the Clinical Scientist (I, II, or SS, 3)** Description of the major components of biochemistry as it relates to the medical sciences. Major concepts include molecular genetics, regulatory biochemistry, and medically related applied biochemistry. *Offered every third year.* Staff

**572 Plant Biochemistry**  
See Plant Sciences 572.

**581 General Biochemistry I (I, 3)** First semester of a two-semester course on the principles of biochemistry. Topics include: bioenergetics, protein structure, enzymology, glycolysis, the tricarboxylic acid cycle, and oxidative phosphorylation. (Lec. 3) *Pre:* CHM 228 and 229. Rhoads and Tremblay

**582 General Biochemistry II (II, 3)** Second semester of a two-semester course on the principles of biochemistry. Topics include: photosynthesis, membranes, hormones, metabolism, the biosynthesis of DNA, RNA, and proteins. (Lec. 3) *Pre:* CHM 228 and 229. Rhoads, Tremblay, and Chandlee

**583 Metabolism (I, 3)** Intensive study of metabolic pathways of carbohydrates, lipids, and nitrogenous compounds; their interrelationships. Effects of hormonal and nutritional status on activity of these pathways. (Lec. 3) *Pre:* 581, 582, and/or permission of chairperson. *In alternate years.* Tremblay

**584 Membrane Biochemistry (II, 3)** Review of model systems for biochemical, physical, and chemical studies of cell membranes. Discussion of current research directed at a molecular understanding of membrane structure and function. (Lec. 3) *Pre:* credit or concurrent enrollment in 582 or permission of instructor. *In alternate years. Next offered 1994–95.* Rhoads

**585 Recent Advances in Receptor Research (I, 1)** Discussion of current research literature about receptors for hormones, pheromones, neurotransmitters, and other biological signals. Consequences of receptor activation will also be discussed. (Lec. 1) *Pre:* 311 and permission of instructor. *May be repeated.* Rhoads

**599 Master's Thesis Research (I and II)** Number of credits is determined each semester in consultation with the major professor or program committee. S/U credit.

**622 Advanced Electron Microscopy**  
See Microbiology 622.

**624 Advanced Electron Microscopy Laboratory**  
See Microbiology 624.

**642 Biochemical Toxicology**  
See Pharmacology and Toxicology 642.

**651, 652 Research in Biochemistry and Biophysics (I and II, 3 each)** Students are required to outline a research problem, conduct necessary literature survey and experimental work, and present the observations and conclusions in a substantial written report. (Lab. 6) *Pre:* graduate standing. Staff

**695, 696 Seminar in Biochemistry and Biophysics (I and II, 1 each)** Presentation of selected topics from current literature or progress in thesis research, as assigned by the instructor. S/U credit. Rhoads

**699 Doctoral Dissertation Research (I and II)** Number of credits is determined each semester in consultation with the major professor or program committee. S/U credit.

## Botany

M.S., Ph.D. (Biological Sciences)  
401-792-2161

### Graduate Faculty

*Chairperson:* Professor Keith T. Killingbeck, Ph.D., 1976, University of North Dakota  
*Director of Graduate Studies:* Assistant Professor Joanna F. Norris, Ph.D., 1982, Michigan State University  
Professor Roger D. Goos, Ph.D., 1958, University of Iowa  
Professor Paul E. Hargraves, Ph.D., 1968, College of William and Mary  
Professor Marilyn Harlin, Ph.D., 1971, University of Washington  
Professor Richard E. Koske, Ph.D., 1971, University of British Columbia  
Professor Theodore J. Smayda, Dr. Philos., 1967, University of Oslo  
Professor Elijah Swift V, Ph.D., 1967, Johns Hopkins University  
Associate Professor John P. Mottinger, Ph.D., 1968, Indiana University  
Assistant Professor Alison W. Roberts, Ph.D., 1990, Texas Tech University  
Adjunct Professor Paul S. Chomet, Ph.D., 1988, State University of New York, Stony Brook  
Adjunct Professor Albert P. Kausch, Ph.D., 1983, Iowa State University  
Adjunct Associate Professor Susan L. Hammen-Winn, Ph.D., 1989, University of Rhode Island  
Adjunct Associate Professor Glen D. Thursby, Ph.D., 1983, University of Rhode Island  
Adjunct Assistant Professor Eric M. Roberts, Ph.D., 1991, University of Texas, Austin

### Specializations

Aquatic botany (marine and freshwater), cell biology, genetics and cytogenetics, mycology, phycology, plant development, plant ecology, plant molecular biology, plant physiology.

### Master of Science

*Admission requirements:* GRE and undergraduate major in the sciences. Candidates lacking undergraduate courses in organic chemistry, physics, mathematics through introductory calculus, and fundamental courses in biological sciences may be re-

quired to make up deficiencies without graduate credit.

The completed application package must be received by April 15.

*Program requirements:* thesis and BOT 581 or 582.

## Doctor of Philosophy (Biological Sciences)

*Admission requirements:* same as for master's degree, which is normally required. Qualifying examination required for those accepted without the master's degree.

The completed application package must be received by April 15.

*Program requirements:* dissertation; BOT 581, 582. Comprehensive examination will require competency in major areas of botany.

## BOT Courses Botany

**418 Marine Botany** (I, 3)

**419 Freshwater Botany** (I, 3)

**432 Mycology: Introduction to the Fungi** (I, 4)

**437 (or ZOO 437) Fundamentals of Molecular Biology** (I, 3)

**445 Plant Physiology** (I, 3)

**451 (or MIC 451) Laboratory in Cell Biology** (II, 1)

**453 (or MIC 453) Cell Biology** (II, 3)

**454 Genetics Laboratory** (I, 3)

**455 (or ZOO 455) Marine Ecology** (I, 3)

**457 (or ZOO 457) Marine Ecology Laboratory** (I, 1)

**465 Phycology: An Introduction to the Algae** (II, 3)

**490 Modern Techniques in Botanical Sciences** (I and II, 2)

**511 Special Readings in Developmental Plant Anatomy** (I, 3) Intensive tutorial work, research, and reading on ontogeny of plant structures and morphogenetic mechanisms. *Pre: graduate standing and permission of instructor. Concurrent audit of 311 required. Offered on demand.* Staff

**512 Morphology of Vascular Plants** (I, 3) Comparative survey of development, form, and anatomy of extinct and extant vascular plants and modern interpretation of evidence concerning their interrelationships. (Lec. 2, Lab. 2) *Pre: 311 or equivalent. In alternate years.* Staff

**521 Recent Advances in Cell Biology**  
See Microbiology 521.

**522 Plant Molecular Biology** (I, 4) Analysis of gene expression in plants including topics such as chloroplast DNA, mitochondrial DNA, transgenic plants, and symbiotic genes. Laboratory includes cloning, restriction mapping, and hybridization. Emphasis on research literature. (Lec. 2, Lab. 4) *Pre: 352, BCP 311, or permission of instructor. In alternate years.* Norris

**524 Methods in Plant Ecology** (II, 3) Methods in analysis of vegetation and microenvironments. Emphasis on quantitative techniques in analysis of vegetation, soil, and microclimate; techniques in physiological ecology. (Lec. 2, Lab. 3) *Pre: 111 and 262 (or ZOO 262) or equivalent; EST 412 recommended. In alternate years. Next offered 1993-94.* Killingbeck

**534 Physiology of the Fungi** (II, 3) Life processes of fungi with particular emphasis on chemical composition, organic and mineral nutrition, toxic and stimulating agencies, and metabolism. Also stresses phenomena of variation of growth and sporulation as affected by various environmental factors. (Lec. 2, Lab. 2) *Pre: 432 or permission of instructor. In alternate years.* Koske

**542 Medical Mycology** (II, 3) Fungi pathogenic for humans and animals. (Lec. 1, Lab. 4) *Pre: 432 or MIC 201 or 211 or permission of instructor. In alternate years.* Goos

**546 Seminar in Plant Stress Physiology** (II, 1-2) Readings, discussion, and analysis of current literature with emphasis on biochemical and genetic aspects of responses. Students electing two credits will write review papers. (Lec. 1) *Pre: one course in plant physiology and one course in biochemistry. In alternate years.* Staff

**551 Seminar in Aquatic Botany** (I, 1) Readings and discussion on current research involving algae and other aquatic plants. (Lec. 1) *Pre: permission of instructor. May be repeated.* Harlin

**554 Cytogenetics** (I, 4) Comparisons of various types of crossing-over, chromosomal aberrations and their effects, mutation, and other cytogenetic phenomena in fungi and higher organisms. Laboratory studies of meiosis in maize, identification of chromosomes, and induced rearrangements. (Lec. 2, Lab. 4) *Pre: 352, 453, or permission of instructor.* Mottinger

**562 Seminar in Plant Ecology** (II, 2) Recent topics and investigations pertinent to plant ecology. Library research, oral presentation of reports, and group discussions. (Lec. 2) *Pre: 262 (or ZOO 262) or equivalent or permission of instructor. May be repeated.* Killingbeck

**579 Advanced Genetics Seminar**  
See Zoology 579.

**581, 582 Botany Seminar** (I and II, 1 each) Preparation and presentation of papers on subjects in selected areas relating to botany. Required of graduate students majoring in botany. (Lec. 1) *S/U credit.* Staff

**590 Botanical Techniques** (I, 1) Current research techniques in the botanical sciences. Includes short-term participation in several ongoing research programs and an overnight, weekend field trip. (Lab. 3) *Pre: graduate standing or permission of instructor.* Staff

**591, 592 Botanical Problems** (I and II, 1-3 each) Special work arranged to meet the needs of individual students who are pre-

pared for and desire advanced work in botany. (Lec. 1-3, Lab. 2-6) *Offered only by arrangement with staff.* Staff

**593 Special Topics** (I and II, 1-3 each) Covers the following specialized areas of botany: a) recent advances in mycology, b) physiological ecology of marine macroalgae, c) nutrient ecology of plants, and d) ecology of fungi. *Pre: permission of instructor. May be repeated for a maximum of 9 credits.* Staff

**599 Master's Thesis Research** (I and II) Number of credits is determined each semester in consultation with the major professor or program committee. *S/U credit.*

**661 Phytoplankton Taxonomy**  
See Oceanography 661.

**663 Phytoplankton Physiology**  
See Oceanography 663.

**664 Phytoplankton Ecology**  
See Oceanography 664.

**667 Advanced Phytoplankton Seminar**  
See Oceanography 667.

**691, 692 Botanical Problems** (I and II, 1-6 each) Special work to meet the needs of individual students who are prepared to undertake special problems. (Lec. 3 or Lab. 6) *Pre: permission of chairperson.* Staff

**693, 694 Research in Botany** (I and II, 3 each) Assigned research; subject matter to be arranged with a faculty member with the approval of the chairperson. (Lab. 6) Staff

**699 Doctoral Dissertation Research** (I and II) Number of credits is determined each semester in consultation with the major professor or program committee. *S/U credit.*

**930 Workshop in Botany Topics for Teachers** (I and II, 0-3 each) Especially designed for teachers of biology. Basic topics of botany from an advanced or pedagogical perspective. *Pre: teacher certification.* Staff

## Business Administration

M.B.A., Ph.D.  
401-792-5000

### Graduate Faculty

*Dean, College of Business Administration:*  
Sydney V. Stern, Ph.D., 1962, Georgia  
Institute of Technology

*Director of Graduate Programs:* Professor  
Richard W. Scholl, Ph.D., 1979,  
University of California, Irvine

*Director of Ph.D. Program:* Associate Professor  
Laura L. Beauvais, Ph.D., 1987,  
University of Tennessee

*Assistant Director, M.B.A. Programs:* Deborah  
F. Booker, M.B.A., 1991, University of  
Maryland

*Accounting*

*Chairperson:* Professor Spencer J. Martin, Ph.D., 1970, University of Illinois; C.P.A.  
 Professor Joseph P. Matoney, Jr., Ph.D., 1973, Pennsylvania State University; C.P.A. (Rhode Island)  
 Professor Henry R. Schwarzbach, D.B.A., 1976, University of Colorado; C.P.A.  
 Professor Richard Vangermeersch, Ph.D., 1970, University of Florida; C.P.A. (Rhode Island)  
 Associate Professor Marshall A. Geiger, Ph.D., 1988, Pennsylvania State University; C.P.A.  
 Associate Professor Mark Higgins, Ph.D., 1989, University of Tennessee; C.P.A.  
 Assistant Professor Judy K. Beckman, Ph.D., 1991, Texas Tech University; C.P.A.  
 Assistant Professor Edmund J. Boyle, Ph.D., 1990, Pennsylvania State University; C.P.A.  
 Assistant Professor Alejandro Hazera, D.B.A., 1989, University of Kentucky; C.P.A.

*Business Law*

Professor Andrew Laviano, J.D., 1965, New York University School of Law  
 Associate Professor John Dunn, J.D., 1977, Boston College Law School  
 Associate Professor Charles Hickox, J.D., 1979, Washington University

*Finance and Insurance*

*Chairperson:* Associate Professor Gordon H. Dash, Jr., D.B.A., 1978, University of Colorado  
 Professor Dennis W. McLeavey, D.B.A., 1972, Indiana University; C.F.A.  
 Professor S. Ghon Rhee, Ph.D., 1978, Ohio State University  
 Associate Professor Rosita P. Chang, Ph.D., 1981, University of Pittsburgh  
 Associate Professor Gene C. Lai, Ph.D., 1987, University of Texas, Austin  
 Associate Professor Blair M. Lord, Ph.D., 1975, University of California  
 Associate Professor Henry R. Oppenheimer, Ph.D., 1979, Purdue University  
 Assistant Professor Jun-Koo Kang, Ph.D., 1991, Ohio State University  
 Assistant Professor Yul Lee, Ph.D., 1987, University of Texas, Austin

*Management*

*Chairperson:* Professor Clay V. Sink, Ph.D., 1968, Ohio State University; C.A.M.  
 Professor Norman Coates, Ph.D., 1967, Cornell University  
 Professor Robert A. Comerford, Ph.D., 1976, University of Massachusetts  
 Professor George deLodzia, Ph.D., 1969, Syracuse University  
 Professor Craig E. Overton, Ph.D., 1971, University of Massachusetts  
 Professor Charles T. Schmidt, Jr., Ph.D., 1968, Michigan State University  
 Professor Richard W. Scholl, Ph.D., 1979, University of California, Irvine  
 Associate Professor Laura L. Beauvais, Ph.D., 1987, University of Tennessee

Associate Professor Elizabeth A. Cooper, Ph.D., 1985, University of Akron  
 Associate Professor Diane M. Disney, Ph.D., 1988, Brandeis University  
 Assistant Professor Sanjiv Dugal, Ph.D., 1991, University of Massachusetts  
 Assistant Professor Linda M. Randall, Ph.D., 1993, University of Massachusetts

*Management Science and Information Systems*  
*Chairperson:* Associate Professor Maling Ebrahimpour, Ph.D., 1986, University of Nebraska

Professor Charles P. Armstrong, Ph.D., 1973, University of Arizona  
 Professor Frank S. Budnick, D.B.A., 1973, University of Maryland  
 Professor Alan B. Humphrey, Ph.D., 1965, North Carolina State University  
 Professor Jeffrey E. Jarrett, Ph.D., 1967, New York University  
 Professor Chai Kim, Ph.D., 1973, University of Pittsburgh  
 Professor Russell C. Koza, Ph.D., 1968, Rensselaer Polytechnic Institute  
 Professor Paul M. Mangiameli, Ph.D., 1979, Ohio State University  
 Professor Richard Mojena, Ph.D., 1971, University of Cincinnati  
 Professor Seetharama Narasimhan, Ph.D., 1973, Ohio State University  
 Associate Professor Roy Ageloff, Ph.D., 1975, University of Massachusetts  
 Associate Professor Shaw K. Chen, M.A., 1979, National Taiwan University  
 Associate Professor Stuart Westin, Ph.D., 1983, University of Massachusetts

*Marketing*

*Chairperson:* Professor Albert J. Della Bitta, Ph.D., 1971, University of Massachusetts  
 Professor Nikhilesh Dholakia, Ph.D., 1975, Northwestern University  
 Professor Ruby Roy Dholakia, Ph.D., 1976, Northwestern University  
 Professor Eugene M. Johnson, D.B.A., 1969, Washington University  
 Professor M. Ven Venkatesan, Ph.D., 1965, University of Minnesota  
 Associate Professor Carol F. Surprenant, Ph.D., 1981, University of Wisconsin  
 Assistant Professor Bari Harlam, Ph.D., 1991, University of Pennsylvania  
 Assistant Professor Kapil Jain, Ph.D., 1989, Columbia University  
 Assistant Professor Deborah Rosen, Ph.D., 1992, University of Tennessee

*Specializations*

*For the M.B.A.:* finance, general management, international management, management science, and marketing.

*For the Ph.D.:* finance, management, management science, and marketing.

*Master of Business Administration*

The Master of Business Administration (M.B.A.) program prepares students for leadership positions in business, government,

and nonprofit organizations. The faculty seeks to develop a global perspective while stressing the ethical and environmental responsibilities inherent in all management activities. The program is offered on the Kingston Campus for full-time and part-time students, and in the evening through the College of Continuing Education in Providence for part-time students. Candidates may begin the program in September or January.

In addition, an M.B.A. for Executives may be completed in 22 months by participating in a program that meets on Fridays and Saturdays at the W. Alton Jones Campus. A group of 20–25 experienced managers (7–10 years of management experience) follows a curriculum that emphasizes computer applications, human relations, organizational behavior, financial analysis, and other areas useful to the effective manager. Applications to the Dean of the Graduate School should specify the M.B.A. program and indicate on which campus study is to be undertaken.

*Admission requirements:* Graduate Management Admissions Test (GMAT), a statement of purpose, a resumé, three letters of recommendation, and transcripts of all previous undergraduate or postbaccalaureate work are required. Work experience is valued. Applicants for whom English is not the native language will be expected to score 575 or above on the TOEFL. The GMAT score and undergraduate quality point average are not the sole criteria for admission. However, those with undergraduate quality point averages of less than B or those with less than 50th percentile scores on the GMAT have a low probability of admission. Applications from well-qualified individuals who can contribute to the cultural and ethnic diversity of the College of Business Administration and of the University are welcome.

*Program requirements:* nonthesis program requires a minimum of 36 credits and a maximum of 54 credits. Of these, 11 credits are designated entry-level courses: ECN 590, QBA 500, 520, and 530. QBA 500, 520, and 530 may be waived upon successful completion of proficiency examinations administered by the Department of Management Science and Information Systems. These courses may also be waived with permission of the chairperson and program director based on successful completion of equivalent college-level courses at an AACSB-accredited institution. ECN 590 may also be waived based on recent completion of college-level courses in micro- and macroeconomics with grades of B or better. If QBA 520 or 530 is waived, the student must take an elective in place of the waived course. If ECN 590 is waived, the program is reduced by three credits. The 43-credit standard program is composed of 31 credits of required courses: ACC 610; BSL 600; FIN 601, 660; MGT 630, 681; MIS 600; MGS 620; MKT 601; OMT 640; plus 12 credits of electives. Of the required courses, the following may be waived (with

the recommendation of the appropriate chairperson and the M.B.A. program director, and the approval of the Dean of the Graduate School) based on significant prior college-level study in the appropriate field (usually multiple courses in the field from an AACSB-accredited program): ACC 610; BSL 600; MGS 620; MGT 630; MIS 600; MKT 601; and OMT 640. Of the 12–18 elective credits, no more than nine may be required in a single field of specialization. Students who do not wish to specialize may choose their electives with the prior approval of the M.B.A. program director and the Dean of the Graduate School.

For the specializations listed here, the courses indicated are either required or recommended, *in addition to the required M.B.A. courses*. Other electives may be used to complement the required courses, but such choices are subject to approval by the M.B.A. program director.

Students are encouraged to participate in internships, which include both practical and academic components. Arrangements must be made through an academic advisor and must include registration in the appropriate course; e.g., MGT 693, 694 Internship in Management. Placements may be arranged through various external organizations.

**Finance** (Coordinator: Professor Gene C. Lai). Students choose electives that emphasize corporate finance, investment management, international finance, speculative markets, or financial institutions. Requirements: FIN 641 and two electives chosen from FIN courses and ECN 538.

**General Management** (Coordinator: Professor Clay V. Sink). Students go beyond the core management courses and study areas such as organizational behavior, theory, and development; human relations; labor relations; entrepreneurship; strategic management; and business law. Requirements: three electives selected from MGT or BSL courses, LRS 541, 542 or 543 (not both), and LRS 545.

**International Management** (Coordinator: Professor Norman Coates). Students study the problems and processes of managing organizations in an interdependent, global environment. Requirements: three electives selected from MGT 655, 656, and 657; MKT 651; FIN 652; LRS/PSC 521; and ECN 538. Students are encouraged to take supplemental interdisciplinary courses in the historical, cultural, social, political, economic, or linguistic differences in management. Those with appropriate levels of second-language proficiency are encouraged to take a business language course.

**Management Science** (Coordinator: Professor Russell C. Koza). Students study the applications of mathematics, statistics, and computer systems to the management of organizations, along with the function of production and operations management. Requirements: three MIS, MGS, or OMT electives, which may be augmented with

courses in computer science, engineering, and mathematics with approval of the program coordinator.

**Marketing** (Coordinator: Professor Albert Della Bitta). Students study essential elements of marketing beyond the fundamentals covered in the core marketing course. Electives are chosen from course offerings.

All 600-level courses offered by departments in the College of Business Administration are open to matriculated graduate students only.

### Doctor of Philosophy

The Doctor of Philosophy program is small and highly selective. Admission is competitive and based on academic merit, research capabilities, and the match of research interests between the applicant and faculty in the indicated area of specialization.

**Admission requirements:** GMAT or GRE, and a master's degree. Applicants with diverse academic backgrounds are encouraged to apply.

Applicants are admitted for September only. Due to limited resources, new admissions to the doctoral program must be limited to a small number each year. Since applicants are evaluated for each of the four specialization areas independently, all applicants must specify a single area of specialization on the application form. Completed application package must be received by March 1; applications completed after that date are reviewed on a space-available basis until the programs are full, and are not guaranteed a full review.

Applicants for whom English is not the native language will be expected to score 575 or above on the TOEFL. The GMAT and GRE scores and master's quality point average are not the sole criteria for admission. However, those with master's quality point averages of less than 3.20 on a 4.00 point scale or those who score lower than the 60th percentile on the GMAT or GRE have a low probability of admission. The average master's quality point average for current doctoral candidates is 3.60, and their GMAT scores average in the top 20th percentile.

**Program requirements:** During the qualifying phase of the program, entering doctoral students must take four written qualifying examinations. These written examinations are scheduled in accounting, financial economics, behavioral science, and decision science. One or more of these examinations may be waived for a student on the basis of course work taken in the last five years.

The advanced study phase includes a minimum of 32 credit hours of advanced course work in the area of specialization, supporting and connected areas, and in research methodology and techniques. Course work during this phase may include seminars, directed studies, research projects, and field work deemed appropriate for the

student's area of specialization. All Ph.D. candidates must include BUS 601 and 602 in their programs of study. Each student is required to write at least three major papers of publishable quality. This phase culminates in a written comprehensive examination covering the student's area of specialization as well as research methods and statistics.

After passing the comprehensive examination, doctoral candidates enter the dissertation research phase and engage in significant research under the supervision of their major professor and the doctoral committee. Doctoral dissertation research is expected to make a major contribution to the state of knowledge in the candidate's field. The dissertation defense is a final oral examination administered according to procedures established by the Graduate School.

The Department of Management Science and Information Systems is also a sponsor of the Ph.D. program in applied mathematical sciences (see page 28).

### General Information

In addition to the University's Academic Computer Center, business students have access to four other computer facilities: the Dennis W. Callaghan Microcomputer Lab, the Computer-Integrated Manufacturing Lab, the college's general computer facility, and a smaller computer laboratory at the College of Continuing Education (see page 7). These facilities are available to both daytime and evening students six days a week.

### ACC Courses

See listing under Accounting, page 28.

### BUS Courses

#### Ph.D. in Business Administration

**601 Practicum in Business (I, 1)** Course involves training and experience in teaching undergraduate business courses under the supervision of a full-time faculty member. Participation in the instructional development program is an essential component of the class. *Pre: enrollment in Ph.D. program in business administration and permission of Ph.D. program director.* Staff

**602 Doctoral Colloquium in Business Administration (II, 1)** Course involves presenting the results of at least one piece of original research to faculty and other Ph.D. candidates. When not presenting, students are expected to play an active role in critiquing the presented research. (Sem.) *Pre: permission of Ph.D. program director.* Staff

**685 Knowledge Systems in Managerial Disciplines (I or II, 3)** Examination of knowledge production and dissemination systems in management disciplines. Discussion of various paradigms and philosophy of science perspectives. Metascientific and research program issues are examined. *Pre: Ph.D. candidate.* Staff

**699 Doctoral Dissertation Research**

(I and II) Number of credits is determined each semester in consultation with the major professor or program committee. *Pre: enrollment in Phase III of the Ph.D. program in business administration. S/U credit.*

**BSL Courses****Business Law**

**442 Property Interests (II, 3)**

**450 Consumer Law and Legislation (I, 3)**

**460 Law and the Entrepreneur (II or SS, 3)**

**501 Law and Accounting (I, 3)** Introduction to CPA law exam, question and answer techniques, coverage of most accounting-related legal subjects currently included on the CPA exam. (Lec. 3) *Pre: 600 or permission of chairperson. Staff*

**600 Legal Environment of Business**

(I and II, 3) Coverage includes both substantive and procedural rules of law in the civil and administrative law field with emphasis on business, regulation, societal, and ethical issues. (Lec. 3) *Pre: graduate standing. Laviano*

**691 Directed Study in Business Law**

(I and II, 1–3) Advanced work under the supervision of a staff member arranged to suit the individual requirements of the student. (Lec. 1–3) *Pre: permission of instructor. Staff*

**FIN Courses****Finance**

**\*401 Advanced Financial Management (I or II, 3)**

**420 Speculative Markets (I or II, 3)**

**\*425 Portfolio Theory and Management (I or II, 3)**

**\*433 Bank Financial Management (I or II, 3)**

**\*452 Multinational Finance (I or II, 3)**

**601 Financial Management (I and II, 4)**

Functions and responsibilities of financial managers. Examination of financial issues, both internal to the firm and arising from interaction with the financial system. Financial statement analysis, structure, valuation, markets, capital budgeting, working capital. (Lec. 4) *Pre: ACC 610, ECN 590, QBA 520 and 530. Staff*

**602 Advanced Financial Management**

(I or II, 3) Case studies and selected readings emphasizing the application of financial theory and analytical techniques to financial management. (Lec. 3) *Pre: 601 or equivalent. Staff*

**622 Security and Investment Analysis**

(I or II, 3) Analysis of the problems of investing funds and managing investments. Use of the latest investment theories and their implementation via quantitative techniques will be explored. (Lec. 3) *Pre: 601 or equivalent. Staff*

**625 Advanced Portfolio Theory and Security Analysis (I or II, 3)** An examination of advanced theories and practices in portfolio building and maintenance. Issues related to

security price behavior are also examined. (Lec. 3) *Pre: 540 or 601 or equivalent. Staff*

**633 Depository Institutions and Financial Management (I or II, 3)**

Study of the financial decisions facing the management of depository institutions. Current financial practices and problems explored. Models for bank managers will be considered. (Lec. 3) *Pre: 601 or equivalent. Staff*

**641 Advanced Financial Theory (I or II, 3)**

Analysis of the theoretical framework for corporate decision making related to financial planning, capital budgeting decisions, dividend policy, and capital structure decisions. Emphasis on current research developments. (Lec. 3) *Pre: 601 or equivalent. Staff*

**652 Advanced International Financial Management (I or II, 3)**

Analysis of issues relevant to the international financial manager. The financial operations of multinational enterprises are examined through both the theoretical and case approach. *Pre: 601 or equivalent. Staff*

**660 Managerial Economics (I and II, 3)** The applications of economic theory and methodology to business problems. (Lec. 3) *Pre: 601, MIS 600, 620, and OMT 640. Staff*

**671 Seminar in Finance (I or II, 3)** Independent research. Individual topics based on readings and research interests of the students. (Lec. 3) *Pre: 601. Staff*

**691, 692 Directed Study in Finance**

(I and II, 1–3 each) Advanced work under the supervision of a staff member arranged to suit the individual requirements of the student. (Lec. 1–3) *Pre: permission of instructor. Staff*

**693 Internship in Finance (I and II, 3)**

Participation in management and/or problem solving under the supervision and guidance of a sponsoring agency with evaluation by the College of Business Administration. *Pre: proposal acceptance by College of Business Administration, no previous internship credit, and graduate standing. S/U credit. Staff*

**697 Doctoral Research Seminar (I and II, 3)**

Provides a rigorous analysis of current research questions and research techniques used to address those questions in the academic discipline. Recent developments and current issues addressed. *Pre: enrollment in Phase II of the Ph.D. program in business administration. Staff*

**INS Courses****Insurance**

**414 Advanced Commercial Property and Liability Insurance (II, 3)**

**433 Social Insurance (I, 3)**

**471 Topics in Insurance (II, 3)**

**691, 692 Directed Study in Insurance (I and II, 1–3 each)** Advanced work under the supervision of a staff member arranged to suit the individual requirements of the student. (Lec. 1–3) *Pre: permission of instructor. Staff*

**MGT Courses****Management**

**402 Leadership and Motivation (I or II, 3)**

**407 Organization and Management Theory II (I and II, 3)**

**408 Organization Development and Change (I or II, 3)**

**422 Labor Law and Legislation (II, 3)**

**431 Advanced Management Seminar (I or II, 3)**

**480 Small Business Management (II, 3)**

**482 Entrepreneurship (I, 3)**

**530 Management Theory and Practice**

(II, 2) Management applied to business; objectives, policies, organizational staffing, and control; production; personnel; behavioral science applications; the role of quantitative methods. (Lec. 2) *Staff*

**626 Organizational Behavior (I, 3)** Incorporates the insights gleaned from the disciplines of psychology, sociology, anthropology, and the social sciences of politics, economics, and history in the study of the behavior of organizations and of their principal actors. (Lec. 3) *Pre: 630 or equivalent. Staff*

**627 Advanced Organizational Theory and Behavior (II, 3)** Previous knowledge of classical and traditional management thought used to provide concepts, analytical approaches, and skills for understanding how behavioral sciences influence complex organizational systems. (Lec. 3) *Pre: 626. Staff*

**630 Organizational Theory and Behavior (I and II, 4)** Management applied to business objectives, policies, organizational staffing and control. Interpersonal dynamics in organizational settings. Role of human resource management. Emphasis on individual and structural factors affecting decision making. (Lec. 4) *Pre: graduate standing. Staff*

**635 Consulting and Management Practice (I or II, 3)** Review of the theory and practice of effective consulting and development of consultation skills. (Lec. 3) *Pre: 630 or permission of instructor. Coates*

**638 Seminar in Management (I or II, 3)**

Class discussion of typical cases, original research work in the field of management with discussion of data collected and analyzed by individual students. (Lec. 3) *Pre: permission of chairperson. Staff*

**639 Advanced Topics in Management (I or II, 3)** Integrated approach to problems in major areas of business management with emphasis on administrative and executive viewpoint. (Lec. 3) *Pre: permission of chairperson. Staff*

**640 Compensation Administration**

(I or II, 3) Compensation and performance appraisal systems. Theory and techniques

\* These courses may not be taken for graduate credit by students in the College of Business Administration.

used to determine job worth. Special issues in compensation management, such as relating pay to performance through appraisal techniques and pay compression. (Lec. 3) Pre: 630. Staff

#### **641 Human Resource Development**

(I or II, 3) Techniques used in procurement and development of human resource. Planning through recruitment, selection, and placement to training and development. Integration of HRD process with organizational strategic plans. (Lec. 3) Pre: 630. Staff

#### **655 International Business Management**

(I, 3) Examines the problems and characteristics of international management by focusing on the role of the multinational corporation in a cross-cultural setting. (Lec. 3) Pre: 630 or equivalent. Staff

#### **656 Japanese Business Systems**

(I or II, 3) A comparative study of Japanese business management systems by means of readings, case studies, and lectures. Focus on management practices in Japanese firms and problems of coping with environmental factors in Japan and the United States. (Lec. 3) Pre: 630 or permission of instructor. Coates

**657 International Comparative Management and Culture** (I or II, 3) An interdisciplinary course which examines the effects of culture on managerial behavior and decision making. (Lec. 3) Pre: 630. Coates

#### **670 Business Environmental Analysis**

(II, 3) Advanced analysis of increasingly complex interrelationships between the business organization and its environment. Emphasis on conceptual foundations of business and the impact of contemporary sociopolitical issues on management decision making. (Lec. 3) Pre: 630 or permission of chairperson. Staff

#### **681 Administrative Policy and Decision Making**

(I and II, 3) Case studies of management problems and evaluation of alternative solutions by integrating functional areas of business. Discussion of ethical, social, and regulatory environments in domestic and multinational firms. Includes the M.B.A. written comprehensive examination. (Lec. 3) Pre: all M.B.A. 500-level first-tier courses or equivalent and a minimum of 21 M.B.A. credits which must include MGT 630, MKT 601, FIN 601, ACC 610, or permission of instructor. Staff

**691, 692 Directed Study in Management** (I and II, 1–3 each) Advanced work under the supervision of a staff member arranged to suit the individual requirements of the student. (Lec. 1–3) Pre: permission of instructor. Staff

#### **693, 694 Internship in Management**

(I and II, 3 each) Participation in management and/or problem solving under the supervision and guidance of a sponsoring agency with evaluation by the College of Business Administration. Pre: proposal acceptance by the College of Business Administration, no previous internship credit, and graduate standing. S/U credit. Staff

**695 Managerial Skills Development** (I, II, and SS, 3) Assessment, feedback, and development of managerial skills; leadership, group decision making and problem solving, negotiation, making presentations, giving feedback, listening. Pre: 630. Staff

**696 Strategic Decision Making** (I, II, SS, 3) Development of the skills and competencies in strategic thinking; use of critical analysis in the diagnosis of organizational and management problems. Serves as foundation for policy course and case method. Pre: graduate standing. deLodzia

#### **697 Doctoral Research Seminar**

(I and II, 3) Provides a rigorous analysis of current research questions and research techniques used to address those questions in the academic discipline. Recent developments and current issues addressed. Pre: enrollment in Phase II of the Ph.D. program in business administration. Staff

### **MIS Courses**

#### **Management Information Systems**

**483 Business Applications Programming** (I, 3)

**484 Management Systems Analysis and Design** (II, 3)

**485 Management of Databases** (I, 3)

**486 Advanced Programming and Information Structures** (II, 3)

**488 Business Software Development Project** (II, 3)

#### **600 Information System Concepts**

(I and II, 2) Concepts, procedures, and managerial issues dealing with information and decision-support systems. Topics include hardware and software; business systems; systems analysis, design, and implementation. (Lec. 2 for one-half semester, second half) Pre: QBA 500, 520, 530 or equivalent. Staff

#### **605 Business Microcomputer Applications**

(I, 3) Microcomputer technology and applications in business. Hardware, software, selection of microcomputer systems, and use of commercial software packages. Student projects and microcomputer laboratory sessions required. (Lec. 3) Pre: 600. Staff

#### **664 Health Information Systems**

(I or II, 3) Concepts associated with the design, implementation, management, and evaluation of administrative and clinical health information systems. (Lec. 3) Pre: QBA 500 or equivalent or permission of instructor. Armstrong, Koza, and Humprey

### **MGS Courses**

#### **Management Science**

**445 Managerial Application of Simulation** (II, 3)

**450 Forecasting: Computer Applications** (I or II, 3)

**465 Advanced Topics in Management Science: Deterministic Models** (II, 3)

**466 Advanced Topics in Management Science: Probabilistic Models** (II, 3)

**470 Advanced Managerial Support Systems** (II, 3)

**475 Bayesian Statistics in Business** (I or II, 3)

**601, 602 Advanced Management Statistics** (I and II, 3 each) Theory and application of regression and correlation analysis, analysis of variance and experimental design, and other multivariate data analyses. (Lec. 3) Pre: QBA 530 or waiver examination. Staff

#### **620 Quantitative Methods for Management**

(I and II, 2–3) Survey of principal operations research/management science models. Linear programming, network, and other mathematical programming models; simulation, decision analysis, and other probabilistic models. (Lec. 2 for one-half semester, first half) Pre: QBA 500, 520, 530 or waiver examinations. Staff

#### **630 Management Statistics with SAS and Personal Computer Software**

(II, 3) Second course in statistical analysis for MBA students. Introduces SAS computer languages and personal software. Regression, business experimental designs, time series, business index numbers, decision theory. (Lec. 3) Pre: QBA 500, 520, and 530 or waiver examinations. Staff

**671 Methods of Business Research** (I and II, 3) An understanding of research methodology and the culmination of such methodology into a term project. (Lec. 3) Pre: QBA 530 or equivalent and permission of chairperson. Staff

#### **674 Business Research Methods: Applied Multivariate Methods**

(I and II, 3) Introduction to multivariate analysis in business with emphasis on applications. (Lec. 3) Pre: QBA 520, 530, MIS 601, or permission of instructor. Staff

#### **675 Applied Time Series Methods and Business Forecasting**

(I and II, 3) Study of time-series methods. Construction and use of Autoregressive Integrated Moving Averages (ARIMA) forecasting models. Applications to strategic decision actions. (Lec. 3) Pre: QBA 520, 530, MIS 601, or permission of instructor. Staff

#### **676 Applied Econometric Methods in Business**

(I and II, 3) Design and construction of large-scale multiequation models to explain and predict behavior in management, production, finance, and marketing. (Lec. 3) Pre: ECN 590, MGS 601, or permission of instructor. Staff

#### **683 Business Decision Theory**

(I or II, 3) A statistical analysis of managerial decision making under uncertainty. Bayesian statistical inference and subjective probability are stressed. Comparisons between Bayesian method and classical statistics are discussed, and applications to business problems are emphasized. (Lec. 3) Pre: QBA 520, 530, or equivalent. Staff

**684 Advanced Mathematical Programming Methods in Management (II, 3)** Introduction to integer, nonlinear, and dynamic programming. Emphasis on application of modern mathematical optimization techniques in single-stage and multiple-stage management decision problems. (Lec. 3) Pre: QBA 500, 520, 530, or waiver examinations and MGS 620. Staff

**691, 692 Directed Study in Management Science (I and II, 1–3 each)** Advanced work under the supervision of a staff member arranged to suit the individual requirements of the student. (Lec. 1–3) Pre: permission of instructor. Staff

**693, 694 Internship in Management Science (I and II, 3 each)** Participation in management and/or problem solving under the supervision and guidance of a sponsoring agency with evaluation by the College of Business Administration. Pre: proposal acceptance by College of Business Administration, no previous internship credit, and graduate standing. S/U credit. Staff

**695 Seminar in Management Science (I or II, 3)** Preparation and presentation of papers on selected topics in management science. Pre: 620. Staff

**697 Doctoral Research Seminar (I and II, 3)** Provides a rigorous analysis of current research questions and research techniques used to address those questions in the academic discipline. Recent developments and current issues addressed. Pre: enrollment in Phase II of the Ph.D. program in business administration. Staff

## MKT Courses Marketing

- \*405 Marketing Communications (I, 3)
- \*406 Product Management (I, 3)
- \*407 Channels of Distribution (II, 3)
- \*408 Pricing Decisions (II, 3)
- \*409 Marketing Policy and Problems (II, 3)
- \*415 Marketing Research (II, 3)
- 416 Marketing Research Applications (II, 3)
- \*434 Advertising Strategy and Management (II, 3)
- 442 Sales Management (II, 3)
- 445 Direct Marketing (I and II, 3)
- 446 Industrial Marketing (I, 3)
- \*451 International Marketing (II, 3)
- \*491, 492 Directed Study (I and II, 1–3 each)

**501 Marketing Theory and Practice (I and II, 2)** Analytical approach to contemporary theory and practice of marketing management. (Lec. 2) Not open to M.B.A. students. Staff

**601 Managerial Marketing (I, 4)** Analysis of marketing problems and determination of marketing policies in product development, promotion, pricing, channel selection; legal aspects. (Lec. 4) Pre: ECN 590, QBA 520 and 530, or equivalent, or permission of instructor. Staff

**611 Buyer Behavior (I or II, 3)** Analysis of major factors influencing the behavior and demand of consumers. Emphasis on using these factors to identify and segment target markets and to assess the effects of these factors on markets. (Lec. 3) Pre: 601 or permission of instructor. Staff

**615 Marketing Research (I or II, 3)** Marketing information needs and appropriate means of providing the requisite information are analyzed. Several major marketing decision areas and their research implications are examined in depth. (Lec. 3) Pre: 601, QBA 520 and 530, ECN 590, or permission of instructor. Staff

**631 Advertising Management (I or II, 3)** A course oriented toward managers responsible for planning, appraising, and administering advertising and promotion activities. (Lec. 3) Pre: 601 or permission of instructor. Staff

**651 International Marketing Management (I and II, 3)** Marketing policy making for the multinational firm; organizing for international marketing; its opportunities, pricing, channels, promotion, and research. (Lec. 3) Pre: 601 or permission of instructor. Staff

**661 Product Management (I or II, 3)** Development of product policies and strategies. Emphasis on organizing the marketing function to deal with various product-related activities including new product development, life cycle strategies, and product deletion. (Lec. 3) Pre: 601 or permission of instructor. Staff

**691, 692 Directed Study in Marketing (I and II, 1–3 each)** Advanced work under the supervision of a staff member arranged to suit the individual requirements of the student. (Lec. 1–3) Pre: permission of instructor. Staff

**693, 694 Internship in Marketing (I and II, 3 each)** Participation in management and/or problem solving under the supervision and guidance of a sponsoring agency with evaluation by the College of Business Administration. Pre: proposal acceptance by College of Business Administration, no previous internship credit, and graduate standing. S/U credit. Staff

**695, 696 Seminar in Marketing (I and II, 3 each)** Preparation and presentation of papers on selected topics in marketing. (Lec. 3) Pre: 601 or permission of instructor. Staff

**697 Doctoral Research Seminar (I and II, 3)** Provides a rigorous analysis of current research questions and research techniques used to address those questions in the academic discipline. Recent developments and current issues addressed. Pre: enrollment in Phase II of the Ph.D. program in business administration. Staff

## OMT Courses Operations Management

**458 Integrated Production Logistics Systems (II, 3)**

**460 Management of Quality Control: Computer Applications (I, 3)**

**640 Production and Operations Management (I and II, 2)** The management of manufacturing and service operations. Topics include: flow processes, inventories, scheduling, capacity, and operations strategy. (Lec. 2 for one-half semester, second half) Pre: QBA 530. Staff

**650 Management of Computer-Integrated Manufacturing Systems (II, 3)** This readings-based seminar explores various aspects of CIM through a managerial framework. It will integrate the design, planning, and execution areas of manufacturing using a CIM-based strategy. (Sem. 3) Pre: 640. Mangiameli

**681 Operations Management in Service Organizations (I or II, 3)** Problems facing operations managers of service organizations are examined. Topics include: flows through services systems, forecasting service demand, capacity planning for service organizations, and scheduling service operations. (Lec. 3) Pre: 640. Staff

## QBA Courses Quantitative Business Analysis

**500 Computing for Management (I and II, 2)** Computer concepts and programming in a high-level language such as BASIC, FORTRAN, or PASCAL. Emphasis on computing as an administrative and analytical tool for applications in management. Includes use of software packages. (Lec. 2 for one-half semester, first half) Graduate credit for non-M.B.A. students only if MIS 600 is completed. Staff

**520 Mathematical Methods for Management (I and II, 3)** Fundamental mathematical methods applied to the understanding and solution of managerial problems. Topics include the solution of systems of linear equations, differential calculus, and related areas. (Lec. 3) Graduate credit for matriculated M.B.A. and M.S. in accounting students only. Staff

**530 Statistical Methods for Management (I and II, 3)** Introductory methods of statistics applied to the understanding and solution of business problems. Topics include concepts of business-decision parameters, classical and subjective probability, probability distribution, inference, sample-size problems, regression, and index numbers. (Lec. 3) Graduate credit for matriculated M.B.A. and M.S. in accounting students only. Staff

\* These courses may not be taken for graduate credit by students in the College of Business Administration.

## Chemical Engineering

M.S., Ph.D.  
401-792-2655

### Graduate Faculty

*Chairperson:* Professor Stanley M. Barnett, Ph.D., 1963, University of Pennsylvania  
*Director of Graduate Studies:* Professor Arijit Bose, Ph.D., 1981, University of Rochester  
 Professor Richard Brown, Ph.D., 1977, University of Cambridge  
 Professor Joseph Estrin, Ph.D., 1960, Columbia University  
 Professor Otto Gregory, Ph.D., 1983, Brown University  
 Professor Harold N. Knickle, Ph.D., 1969, Rensselaer Polytechnic Institute  
 Professor Thomas J. Rockett, Ph.D., 1963, Ohio State University  
 Professor Vincent C. Rose, Ph.D., 1964, University of Missouri  
 Associate Professor Donald J. Gray, Ph.D., 1980, University of Rhode Island  
 Assistant Professor Mercedes Rivero-Hudec, Ph.D., 1986, University of Pennsylvania  
 Adjunct Assistant Professor Everett Crisman, Ph.D., 1984, Brown University

### Specializations

*Biochemical engineering:* reactors, purification methods, degradation, and chemical production.

*Environmental engineering:* separation methods, heavy metal removal, hazardous waste minimization, and desalination.

*Food engineering:* membrane processes.

*Materials engineering:* corrosion and erosion, electronic materials processing, ceramic processing polymer films, conducting polymers and phase equilibria.

*Transport phenomena:* crystal growth, nucleation from solution, interfacial and colloidal phenomena, filtration, flow through porous media, multiphase fluid mechanics, and diffusion through polymers.

*Energy engineering:* analysis of energy systems, multiphase flow and coal liquefaction.

*Unit operations:* crystallization, mixing, chromatography, electrodialysis, ultrafiltration and microfiltration.

### Master of Science

*Admission requirements:* bachelor's degree in chemical engineering; candidates from other engineering fields or from mathematics, biology, chemistry, or physics may be accepted into the program with possible addition of prerequisite courses.

*Program requirements:* thesis option—CHE 501, 502. Nonthesis option for part-time students, with permission of the department; master's examination and comprehensive report with oral examination.

### Doctor of Philosophy

*Admission requirements:* M.S. degree in engineering (may be waived for University of Rhode Island graduate students who pass qualifying examination with superior performance).

*Program requirements:* candidate's program will be determined in consultation with his or her committee and will be based on his or her background and career goals. A comprehensive examination is required to complete the program. There is no general language requirement, but a student's committee may require a foreign language or research tool that may be necessary for the candidate's program. In addition to an acceptable dissertation, a candidate must submit a manuscript, based on his or her research, suitable for publication in a technical journal. CHE 501, 502 is also required.

### CHE Courses Chemical Engineering

**403, 404 (or OCE 403, 404) Introduction to Ocean Engineering Processes I, II (I and II, 3 each)**

**425 Process Dynamics and Control (II, 3)**

**437 Materials Engineering (I and II, 3)**

**438 Failure Analysis and Prevention (II, 3)**

**439 Nondestructive Evaluation of Materials (II, 3)**

**447 (or FSN 447) Food Engineering (I, 4)**

**464 Industrial Reaction Kinetics (I, 3)**

**501, 502 Graduate Seminar (I and II, 1 each)**

Seminar discussions including the presentation of papers based on research or detailed literature surveys. (*Lec. 1*) Required of all resident graduate students, with a maximum of 1 credit per year allowed. May be repeated for a maximum of 2 credits. S/U credit. Rose

**513 Advanced Chemical Engineering Thermodynamics (I, 3)** Applications of the first, second, and third laws of thermodynamics and their relation to chemical engineering processes. Emphasis on properties of fluids, chemical and physical equilibria, and refrigeration. (*Lec. 3*) Pre: 313, 314 or equivalent, graduate standing, or permission of chairperson. In alternate years. Estrin

**530 Polymer Chemistry (I, 3)** Polymer structure, molecular forces, glass and crystalline transitions, solution properties, polymerization kinetics, molecular weight distribution, fractionation, viscoelastic properties, and transport processes. (*Lec. 3*) Pre: CHM 228 and CHE 332 or permission of instructor. Barnett

**531 Polymer Engineering (I or II, 3)** Polymer processing and mechanical properties of plastics, fibers, and elastomers. (*Lec. 3*) Pre: 348 or MCE 448 or permission of instructor. Barnett

**532 Ceramic Engineering (I, 3)** Properties of ceramic materials as related to starting materials and forming, densification, and finishing processes. Emphasis on resulting phases and microstructure. Application of

physical and chemical principles to tailor properties to engineering needs. (*Lec. 3*) Pre: 437 or equivalent. Rockett and Gregory

**533 Engineering Metallurgy (II, 3)** Structures and properties of metals and alloys required to meet typical engineering problems; proper selection of tool materials; properties of stainless steels; materials of special importance in nuclear fields, etc. (*Lec. 2, Lab. 3*) Pre: 333 or permission of instructor. Brown

**534 (or OCE 534) Corrosion and Corrosion Control (II, 3)** Chemical nature of metals, electrochemical nature of corrosion. Types of corrosion, influence of environment, methods of corrosion control. Behavior of engineering materials in corrosion with emphasis on industrial and ocean environments. (*Lec. 3*) Pre: permission of instructor. Brown

**535 (or OCE 535) Advanced Course in Corrosion (I, 3)** High-temperature corrosion, oxidation by gaseous environments, industrial problems with high-temperature corrosion. Materials selection and techniques to combat high-temperature corrosion. (*Lec. 3*) Pre: 534 (or OCE 534) or permission of instructor. Brown and Gregory

**537 (or OCE 537) Advanced Materials Engineering (II, 3)** Engineering properties, molecular design, and applications of materials. Synthesis, fabrication, and processing of materials. Effects of environment on materials, materials products, devices, and systems. (*Lec. 3*) Pre: 437 and PHY 341. Gregory

**539 Electron and Light Microscopy of Solids (I, 3)** Theory and physical principles governing the design and use of light and electron optical systems in identification, analysis, and structural characterization of metals, ceramics, polymers, glasses, and composites. Emphasis on polarized light and scanning electron microscopy. (*Lec. 3*) Pre: 437 or equivalent. In alternate years. Gregory

**540 Phase Equilibria (II, 3)** Interpretation, construction, and thermodynamics of one, two, three to n-component phase diagrams with examples of their use in chemical, ceramic, metallurgical, and mineral engineering. Pre: CHM 431 or equivalent. Rockett

**541 Transport Phenomena I (I, 3)** Analysis of transport processes in fluids with emphasis on diffusion of matter. (*Lec. 3*) Pre: 347, 348 or equivalent, graduate standing, or permission of chairperson. Bose

**542 Advances in Interfacial Phenomena (I, 3)** Topics will include capillarity, surface tension; surface thermodynamics, electrical aspects of surface chemistry; contact angles and wettability; emulsions and foams; adsorption from solutions; hydrodynamic stability of interfaces. (*Lec. 3*) Pre: CHM 431, 432, or equivalent or permission of instructor. Bose

**548 (or FSN 548) Separations for Biotechnology (II, 3)** A study of methods of concentration used in the biotechnology industries for production and isolation of products. Pre: 348 or 447. Barnett

**549 (or FSN 549) Food and Biochemical Engineering (II, 3)** Processing of biochemicals with emphasis on protein production, unit operations of protein recovery, immobilized enzyme reactors, and hydrocolloid rheology. (Lec. 2, Lab. 3) Pre: 447 or FSN 431 or permission of instructor. In alternate years. Barnett and Rand

**560 Chemical and Physical Processes of Integrated Circuit Fabrication (I, 3)** Chemical and physical processes used in the fabrication of integrated circuits and devices. Emphasis on crystal growth, oxidation, CVD, plasma processes, photochemical processes, solid-state diffusion, lithography, and their relation to device performance. (Lec. 3) Pre: CHM 431, CHE 349, or equivalent. Gregory

**572 X-ray Diffraction and Fluorescence (I, 3)** Fundamentals, properties, and applications of X-rays for identification and chemical analysis of materials, determination of lattice parameters, phase transformations, textures, residual stresses, grain and particle sizes, film and plate thicknesses. (Lec. 2, Lab. 3) Pre: PHY 341. In alternate years. Staff

**573 Mechanical Metallurgy (I or II, 3)** Behavior and response of metals to mechanical plastic forming. Property control by analysis and design of industrial metal processing. Principles of annealing, forging, rolling, extruding, rod, wire, and tube drawing. Recent advances and developments. (Lec. 3) Pre: permission of instructor. Brown and Gregory

**574 Biochemical Engineering I (I, 3)** Introduction to biotechnology. Includes properties of biological materials, dynamics, control, and operation of biological systems and processing of biological materials. (Lec. 3) Pre: permission of instructor. Barnett

**591, 592 Special Problems (I and II, 1–6 each)** Advanced work under the supervision of a staff member arranged to suit the individual requirements of the student. (Lec. or Lab. according to nature of problem) Pre: permission of chairperson. May be repeated for a maximum of 12 credits. Staff

**599 Master's Thesis Research (I and II)** Number of credits is determined each semester in consultation with the major professor or program committee. S/U credit.

**614 Advanced Chemical Engineering Thermodynamics (II, 3)** Continuation of 513. (Lec. 3) Pre: 513. Estrin

**641 Transport Phenomena II (II, 3)** Steady, unsteady, and multidimensional heat conduction; convection. Mass transport at low and high fluxes; diffusion and chemitheaty; approximate methods for heat and mass transfer problems. (Lec. 3) Pre: 541 or permission of instructor. Bose

**643 Fluid Dynamics (II, 3)** Advanced problem course dealing with isothermal and nonisothermal flow of compressible and incompressible fluids. (Lec. 3) In alternate years. Knickle

**644 Process Heat Transfer (II, 3)** Advanced study of heat transfer by conduction in the steady and unsteady state, radiation, and convection. (Lec. 3) In alternate years. Knickle

**647 Mass Transfer I (I, 3)** Advanced course dealing with the application of mass transfer theory in the distillation of binary, multicomponent, and complex mixtures. (Lec. 3) In alternate years. Gray

**648 Mass Transfer II (II, 3)** Advanced study of vapor-liquid equilibria and mass-transfer theory applied to gas-liquid systems; humidification and gas absorption, simple and multicomponent systems, with and without chemical reaction. (Lec. 3) Gray

**650 Advanced Topics in Heat Transfer** See Mechanical Engineering 650.

**664 Applied Reaction Kinetics (II, 3)** Application of principles of chemical reaction kinetics to industrial processes. (Lec. 3) In alternate years. Staff

**691, 692 Special Problems (I and II, 1–6 each)** Advanced work under the supervision of a staff member arranged to suit the individual requirements of the student. (Lec. or Lab. according to nature of problem) Pre: permission of chairperson. May be repeated for a maximum of 12 credits. Staff

**699 Doctoral Dissertation Research (I and II)** Number of credits is determined each semester in consultation with the major professor or program committee. S/U credit.

## Chemistry

M.S., Ph.D.  
401-792-2318

### Graduate Faculty

**Chairperson:** Professor Wilfred H. Nelson, Ph.D., 1962, University of Minnesota  
Professor Elie Abushanab, Ph.D., 1965, University of Wisconsin  
Professor Christopher W. Brown, Ph.D., 1967, University of Minnesota  
Professor Phyllis R. Brown, Ph.D., 1968, Brown University  
Professor Clair J. Cheer, Ph.D., 1964, Wayne State University  
Professor Joel A. Dain, Ph.D., 1957, Cornell University  
Professor William B. Euler, Ph.D., 1979, Florida State University  
Professor James L. Fasching, Ph.D., 1970, Massachusetts Institute of Technology  
Professor Harold W. Fisher, Ph.D., 1959, University of Colorado  
Professor David L. Freeman, Ph.D., 1972, Harvard University  
Professor Louis J. Kirschenbaum, Ph.D., 1968, Brandeis University  
Professor Raymond P. Panzica, Ph.D., 1972, University of Utah

Professor William M. Rosen, Ph.D., 1967, University of California, Riverside  
Professor Yuzuru Shimizu, Ph.D., 1962, Hokkaido University  
Professor Daniel D. Traficante, Ph.D., 1962, Massachusetts Institute of Technology  
Professor Bruno M. Vittimberga, Ph.D., 1957, University of Illinois  
Professor Sze Cheng Yang, Ph.D., 1973, Columbia University  
Associate Professor R. Ken Forcé, Ph.D., 1974, University of Nebraska  
Associate Professor Karen I. Peterson, Ph.D., 1982, University of Colorado, Boulder  
Assistant Professor Cynthia G. Zoski, Ph.D., 1985, Trent University  
Adjunct Professor Paul J. Berner, Ph.D., 1964, Stevens Institute of Technology  
Professor Emeritus Paul I. Abell, Ph.D., 1951, University of Wisconsin  
Professor Emeritus Leon Goodman, Ph.D., 1950, University of California, Los Angeles

### Specializations

**Analytical chemistry:** electrochemistry, vibrational spectroscopy, neutron activation analysis, high-performance liquid chromatography, laser spectroscopy.

**Inorganic chemistry:** light scattering, two-dimensional conductors, solution kinetics, organometallics, macrocyclic complexes, metal oxidation states.

**Organic chemistry:** carbohydrates, heterocycles, synthesis, electron transfer, reaction dynamics, geochemistry, structural analysis.

**Physical chemistry:** catalysis, molecular spectroscopy, theoretical chemistry, surface chemistry, conducting polymers, statistical mechanics.

### Master of Science

**Admission requirements:** GRE only for graduates of non-U.S. universities, with advanced test strongly recommended. Preference is given to candidates with undergraduate majors in chemistry or chemical engineering with mathematics through calculus.

**Program requirements:** placement examination to determine specific program requirements, successful completion of master's qualifying examinations; for thesis option (31 credits), 12 credits of graduate core courses in at least three of the four areas of chemistry, one additional graduate-level course in chemistry, CHM 641 or 642, and thesis; for nonthesis option (36 credits), 18 credits of graduate core courses, CHM 641 or 642, CHM 551, 552, and a written comprehensive examination.

### Doctor of Philosophy

**Admission requirements:** same as for master's degree.

**Program requirements:** successful completion of qualifying examination; 15 credits of

graduate core courses, one additional graduate-level course in chemistry, and CHM 641–643 (3 credits). Comprehensive examination and dissertation.

## CHM Courses Chemistry

**401 Intermediate Inorganic Chemistry** (I, 3)

**402 Physical Inorganic Laboratory** (II, 2)

**412 Instrumental Methods of Analysis** (II, 2)

**414 Instrumental Methods of Analysis Laboratory** (II, 2)

**425 Qualitative Organic Analysis** (I, 2)

**427 Intermediate Organic Chemistry** (I, 3)

**431, 432 Physical Chemistry I, II**  
(I and II, 3 each)

**501 Advanced Inorganic Chemistry I** (I or II, 3) Systematic analysis of bonding schemes and structural aspects of molecular systems encountered in inorganic chemistry. Special emphasis on electron density distributions, physical methods of analysis, and practical applications of quantum mechanics. (Lec. 3) Pre: 401. Kirschenbaum

**502 Advanced Inorganic Chemistry II** (II, 3) Modern inorganic chemistry approached from experimental, theoretical, and descriptive points of view. Includes electronic structure and bonding in coordination chemistry, topology, thermodynamics of complex formation, mechanisms, lanthanides, and actinides. (Lec. 3) Pre: 401 or equivalent. Nelson

**504 Physical Methods of Inorganic Chemistry** (II, 3) Theory and application of numerous experimental techniques used for the elucidation of molecular and electronic structure of inorganic molecules. Primary emphasis is on nuclear magnetic resonance, optical, infrared, Raman, and electron paramagnetic resonance spectroscopies. (Lec. 3) Pre: 401 or permission of instructor. Euler

**511 Advanced Analytical Chemistry I** (I, 3) Fundamentals of electrochemistry, including a review of electricity and how it passes through conductors, electrochemical cells, electrode reactions, ionic solutions, polarization, transport mechanisms, voltammetry. Statistical treatment of experimental data. (Lec. 3) Pre: 412 or permission of instructor. Zoski

**512 Advanced Analytical Chemistry II** (II, 3) Continuation of 412 with emphasis on principles and recent developments in application of physicochemical phenomena to solution of chemical problems. (Lec. 3) Pre: 412, PHY 340, and MTH 243. P. Brown

**518 Radiochemistry** (II, 3) Theory and principles of nuclear science as applied to the various fields of chemistry. Radioactivity, radiation detection and measurement, preparation and separation of radionuclides, emphasis on solution of chemical and environmental research problems with the techniques of nuclear chemistry. (Lec. 3) Pre: 432, PHY 214 or permission of instructor. Fasching

**519 Theoretical Concepts in NMR** (I, 3) The physical concepts of NMR phenomena are presented, beginning with signals generated in the probe, carried through the spectrometer console, into the computer, and finally represented as a spectrum. (Lec. 3) Pre: 292, PHY 112, and MTH 141, or equivalents, or permission of instructor. Traficante

**520 Interpretation of One-Dimensional NMR Spectra** (II, 3) Uses of chemical shifts and coupling constants are presented for interpreting one-dimensional (1D) proton and carbon spectra. Includes relaxation time measurements, decoupling, and simple 2D interpretation. (Lec. 3) Pre: 292, PHY 112, and MTH 141 or equivalents, or CHM 519 or permission of instructor. Traficante

**521 Advanced Organic Chemistry I** (I, 3) Emphasis on fundamental organic structure theory and reaction mechanisms. (Lec. 3) Pre: 226 and 228 or equivalent. Vittimberga

**522 Advanced Organic Chemistry II** (II, 3) Modern synthetic reactions and their application to such areas as natural products. (Lec. 3) Pre: 521 or permission of instructor. Cheer

**524 Interpretation of Two-Dimensional NMR Spectra** (II, 3) Covers the theoretical and practical aspects of two-dimensional (2D) NMR. Includes pulse sequences, instrument set-up, and chemical applications. (Lec. 3) Pre: 519 and 520 or permission of instructor. Traficante

**531 Advanced Physical Chemistry I** (I, 3) Principles and applications of classical physical chemistry. Includes the three laws of thermodynamics, thermochemistry, phase equilibria, kinetic rate laws, and mechanisms of gas phase reactions. (Lec. 3) Pre: 432 or permission of instructor. Freeman

**532 Advanced Physical Chemistry II** (II, 3) Introduction to modern chemistry with emphasis on quantum chemistry and statistical thermodynamics. Includes development of quantum theory, applications of quantum theory, development and application of statistical distribution functions. (Lec. 3) Pre: 432 or permission of instructor. Freeman

**551, 552 Nonthesis Master's Research** (I and II, 3 each) Research on original problem for fulfillment of research requirement of nonthesis master's degree. Literature survey, laboratory work, and detailed report required. (Lab. 9) Pre: permission of chairperson.

**566 Foundations for Advanced Chemical Research** (I and II, 2–6) Directed studies in the foundations and procedures necessary for conducting advanced chemical research. Topics will include library, laboratory, and computer skills. Pre: 12 credits of chemistry at the graduate level. May be repeated for a maximum of 6 credits. Staff

**599 Master's Thesis Research** (I and II) Number of credits is determined each semester in consultation with the major professor or program committee. A mini-

mum of 6 credits is required of students who have chosen the thesis option for the master's degree. S/U credit.

**602 The Transition Metals** (I, 3) Ligand field theory and its applications. Basic quantum mechanical calculations involving thermodynamical, spectral, and magnetic properties of transition metal compounds. (Lec. 3) Pre: 502. Nelson

**608 Inorganic Reaction Mechanisms** (I or II, 3) Kinetics and mechanisms of reactions in aqueous solution: techniques, results, and theoretical interpretation. Instrumentation for studying rapid reactions in solution, relaxation methods, electron transfer rates, hydrolytic and solvolytic reactions, metal ion complexation, reactions of biochemical significance. (Lec. 3) Pre: 502 or permission of instructor. Next offered fall 1994. Kirschenbaum

**616 Applied Analytical Techniques** (II, 3) Application of analytical instrumentation and techniques to practical problems. Limitations and specific difficulties of analyzing complex matrices in practical research. Problem-oriented presentation. (Lec. 3) Pre: 511 and 512 or permission of instructor. P. Brown

**617 Advanced Instrumentation** (II, 3) Basic design and theory of instrument design. Discussion of advantages and limitations of specific instruments. Current research in instrument design and critical evaluation of designs. (Lec. 3) Pre: 511 and ELE 220 or 537 or its equivalent. Forcé

**618 Theory of Separations** (II, 3) In-depth presentation of theory of separation processes. Emphasis on methods development, advanced topics, and current advances using gas and liquid chromatography. (Lec. 3) Pre: 511 or permission of instructor. P. Brown

**621 Advanced Topics in Physical Organic Chemistry** (I, 3) Mechanistic aspects of organic chemistry: molecular orbital theory, thermal and photochemical cycloadditions and rearrangements. Consideration of carbenes, nitrenes, and free radicals. Evaluation of steric, stereoelectronic, and secondary orbital effects. (Lec. 3) Pre: 521 and 522 or permission of instructor. Staff

**623 Advanced Topics in Synthetic Organic Chemistry** (I, 3) Advanced topics in the synthetic aspects of organic chemistry. Synthetic reactions and techniques, strategies, and design. Conformational and stereochemical analyses, asymmetric synthesis, and natural product syntheses. (Lec. 3) Pre: 521 and 522 or permission of instructor. Staff

**636 Advanced Topics in Physical Chemistry** (II, 3) Advanced topics in quantum chemistry and statistical thermodynamics. Time-dependent and independent perturbation theory, interaction of light with matter, electronic structure of atoms and molecules, Hartree-Fock theory, classical and quantum statistical mechanics. (Lec. 3) Pre: 531, 532, or permission of instructor. Freeman

**642, 643, 644 Graduate Seminar**

(I and II, 1 each) Results of detailed literature surveys are presented orally and in writing. Required for candidates for advanced degrees in chemistry. (Lec. 1) S/U credit. Staff

**691 Special Topics (I and II, 1-3)** Covers the following special research interests: a) carbohydrate chemistry, b) chemical kinetics, c) clinical chemistry, d) computer techniques in analytical chemistry, e) forensic chemistry, f) free-radical rearrangements, g) recent advances in analytical chemistry, h) light scattering, i) molecular orbital theory, j) pericyclic reactions, k) surface chemistry, l) X-ray analysis of organic molecules. (Lec. 2) Pre: permission of instructor. May be repeated for a maximum of 6 credits. Staff

**699 Doctoral Dissertation Research**

(I and II) Number of credits is determined each semester in consultation with the major professor or program committee. S/U credit.

**930 (or EDC 930) Workshop in Chemistry Topics for Teachers (I and II, 0-3)** Especially designed for teachers of physical sciences. Basic topics of chemistry from an advanced or pedagogical perspective. Pre: teacher certification. Forcé, Peterson, Yang, Euler, and Long

## Civil and Environmental Engineering

M.S., Ph.D.  
401-792-2692

**Graduate Faculty**

*Chairperson:* Professor Daniel Urish, Ph.D., 1978, University of Rhode Island; P.E.

*Director of Graduate Studies:* Associate Professor George E. Veyera, Ph.D., 1985, Colorado State University

Professor William D. Kovacs, Ph.D., 1968, University of California, Berkeley; P.E.

Professor Kang W. Lee, Ph.D., 1982, University of Texas, Austin; P.E.

Professor Everett E. McEwen, D.Eng., 1964, Rensselaer Polytechnic Institute

Professor Calvin P. Poon, Ph.D., 1964, University of Illinois; P.E.

Professor Armand J. Silva, Ph.D., 1965, University of Connecticut; P.E.

Professor Raymond M. Wright, Ph.D., 1981, Pennsylvania State University; P.E.

Associate Professor Dimitrios Karamanlidis, D.Eng., 1979, Technical University of Berlin

Associate Professor Alan S. Marcus, Ph.D., 1969, University of Massachusetts

Associate Professor Leon T. Thiem, Ph.D., 1982, University of Missouri; P.E.

Associate Professor George Tsiatas, Ph.D., 1984, Case Western Reserve University

Assistant Research Professor Eid Alkhatib, Ph.D., 1986, University of Rhode Island

Adjunct Professor Thomas E. Wright, M.S.E., 1975, West Virginia University; P.E.

Adjunct Associate Professor Michael C.

Apostol, Ph.D., 1974, State University of New York, Buffalo

Adjunct Associate Professor Robert B. Shaw, M.S., 1966, Purdue University; P.E.

Adjunct Assistant Professor Diane L. Badorek, Ph.D., 1982, University of Missouri; P.E.

**Specializations**

*Environmental engineering:* water supply and treatment facilities, municipal and industrial waste treatment, flocculation and coagulation of wastes, pollution of marine sediments, solid waste management, modeling of environmental systems, groundwater pollution, groundwater exploration, coastal groundwater, nonpoint source pollution, stormwater management, river and estuary hydrology.

*Geotechnical engineering:* properties of marine sediments, sediment sampling, in situ testing, deep-sea sedimentary processes, sediment transport, creep processes, environmental geotechnology, dredge material disposal, experimental geomechanics, soil-structure interaction, constitutive modeling of geological materials, particulate mechanics, application of nonlinear finite element and discrete element methods to geomechanics problems, earthquake engineering, dynamic soil properties, liquefaction, geosynthetics.

*Structural engineering:* matrix and finite element analysis, computer and numerical methods, marine structures, structural stability, thin-walled structures, coastal structures, deterministic and stochastic structural dynamics, structural reliability, vibration control, earthquakes, soil-structure interaction, condition assessment and rehabilitation of bridges.

*Transportation engineering:* properties of pavement materials, pavement theory and design, pavement management system, highway location, and geometric design. For master's level only: traffic operation and control, transportation cost, transportation supply and demand analysis, and transportation system analysis.

**Application Deadlines**

The completed application package for graduate admission must be received according to the following schedule: fall admission, April 15; spring admission, November 15; summer admission, April 15.

**Master of Science**

*Admission requirements:* bachelor's degree in civil or environmental engineering. Candidates in other engineering fields or in mathematics, biology, chemistry, or physics may be accepted with the possibility of additional undergraduate prerequisite courses being required.

*Program requirements:* thesis or nonthesis option. Thirty credits plus CVE 601, 602 except for part-time students. Nonthesis option

requires comprehensive technical report and written comprehensive examination.

**Doctor of Philosophy**

*Admission requirements:* master's degree in civil or environmental engineering or in a related field.

*Program requirements:* 24 credits including the two-course minor outside the candidate's area of specialization, where required, comprehensive examination, and dissertation. Although there is no formal departmental language requirement, the candidate's committee may require proficiency with a research tool or in a foreign language. The candidate's committee may also require a two-course minor outside the candidate's area of specialization.

**CVE Courses****Civil and Environmental Engineering**

**442 Traffic Engineering (I, 3)**

**446 Transportation Engineering (II, 3)**

**453 Computer Analysis of Structures (I, 3)**

**470 Water and Wastewater Transport Systems (II, 3)**

**471 Water and Wastewater Treatment Systems (I or II, 3)**

**472 Industrial Air Pollution (I or II, 3)**

**474 Water Quality Sampling and Analysis (II, 3)**

**475 Water in the Environment (II, 3)**

**478 Hazardous Waste Disposal and Solid Waste Management (I or II, 3)**

**483 (or OCE 483) Foundation Engineering (II, 3)**

**485 (or GEL 485) Engineering Geophysics (II, 3)**

**491, 492 Special Problems (I and II, 1-6 each)**

**495 Civil and Environmental Engineering Systems (I, 3)**

**545 Pavement Design (I, 3)** Pavement types; pavement system components; stresses in the pavement structure. Design factors and criteria, pavement stabilization, structural design of flexible and rigid pavements for highways and airports, pavement maintenance and overlay design. (Lec. 3) Pre: 347 or equivalent. Offered fall of odd-numbered years. Lee and Kovacs

**546 Urban and Rural Transportation**  
See Community Planning 546.

**547 Geometric Design of Highways (I, 3)** Evaluation of alternative designs. Criteria and practices of geometric design; at grade intersections, interchanges, channelization, weaving parking facilities, and road appurtenances; safety considerations, lane balancing, ramps, and terminals. (Lec. 3) Pre: 347 or equivalent. Offered fall of even-numbered years. Next offered fall 1994. Lee

**548 Pavement Materials and Mix Design (II, 3)** Surficial soils. Material characterization and testing; elastic, viscoelastic, and plastic behavior. Fracture, fatigue, and rutting; design of bituminous mixtures. Other

pavement materials and additives. Pavement recycling. (Lec. 2, Lab. 3) Pre: 347 or equivalent. Offered spring of even-numbered years. Next offered spring 1994. Lee

**551 Finite Element Analysis in Civil Engineering I** (I or II, 3) Direct stiffness method. Rayleigh-Ritz and Galerkin methods. Isoparametric elements. Frames, trusses, plane stress and strain. Bending of thin plates. (Lec. 3) Pre: 453 or permission of instructor. Staff

**556 Variational Methods in Structural Engineering** (I, 3) Introduction; principle of minimum potential energy; principle of minimum complementary energy; generalized variational formulations; principles with relaxed continuity requirements; application to structures, and soils. (Lec. 3) Pre: 453 or permission of instructor. Offered every fourth year. Next offered fall 1996. Karamanlidis

**560 Structural Design** (I or II, 3) Behavior and design of structural systems, selected topics in steel, reinforced concrete, and prestressed concrete. (Lec. 3) Pre: 460 and 465. Offered every third year. Next offered spring 1996. McEwen, Marcus, and Tsiatas

**561 Advanced Steel Design** (I, 3) Selected topics in structural steel design following the LRFD specification, including plate buckling and postbuckling, torsion, plate girders, plastic design, frame stability, tall buildings, composite design, and earthquake-resistant design. (Lec. 3) Pre: 460 or permission of instructor. Offered in alternate years. Next offered fall 1994. Tsiatas

**565 Structural Dynamics** (I or II, 3) Simplified models and their equations of motion; analytical solution methods; Fourier analysis; Duhamel integral; nonlinearities; computer-oriented solution algorithms and their implementation. Applications. (Lec. 2, Lab. 3) Pre: 453. In alternate years. Next offered fall 1995. Staff

**568 (or MCE 568) Theory of Plates** (I or II, 3) Development of basic plate equations. Classical solution examples of rectangular and circular plates. Additional topics selected from: orthotropic plates, large deflections, finite element, and numerical solutions. (Lec. 3) Pre: 220 and MTH 244. Karamanlidis and Nash

**570 Sanitary Chemistry** (I, 3) Application of analytical chemistry to analysis of natural waters; physical chemistry and organic chemistry of aqueous media; chemical principles applicable to operations of sanitary engineering. (Lec. 3) Pre: permission of instructor. Thiem

**571 Sanitary Chemistry Laboratory** (II, 3) Applications of chemical laboratory procedures to control of water and wastewater treatment processes. (Lec. 2, Lab. 3) Pre: 570. Thiem

**572 Biosystems in Sanitary Engineering** (I or II, 3) Microorganisms which constitute the biological systems in water pollution, water purification, and wastewater treatment. Application of principles of microbiology and biochemistry to analysis and design in fields of sanitary engineering and water resources. (Lec. 3) Pre: permission of instructor. Poon

**573 Theory of Water Purification and Treatment** (I, 3) Principles of modern water purification and engineering practices. Aeration, deodorization, sterilization, coagulation, filtration, water softening, iron removal, disinfection, and corrosion control. (Lec. 3) Thiem

**575 Open-Channel Hydraulics** (I or II, 3) Analysis of uniform, critical, varied flow, and unsteady flow in open channels. Principles will be applied to open-channel design. (Lec. 3) Pre: MCE 354. Wright

**581 (or OCE 581) Experimental Geomechanics** (I or II, 3) Advanced methods and techniques of geotechnical testing. Behavior of granular and cohesive soils with determination of engineering properties. Interpretation, evaluation, and engineering applications of test data. Emphasis on shearing strength, consolidation, bearing capacity, earth pressures, seepage, and slope stability. (Lec. 2, Lab. 3) Pre: 381 or equivalent. Kovacs, Silva, and Veyera

**582 Seabed Geotechnics**  
See Ocean Engineering 582.

**583 (or OCE 583) Advanced Foundation Engineering** (I or II, 3) Applications of soil mechanics principles to analysis and design of pile foundations, drilled piers, flexible retaining structures, braced excavations, cofferdams, miscellaneous advanced foundation problems. (Lec. 3) Pre: 381 or equivalent. Offered in fall of even-numbered years. Next offered fall 1994. Kovacs, Silva, and Veyera

**585 Soil Dynamics** (I or II, 3) Vibration characteristics, wave propagation in soils, foundation vibration theory, foundation design for vibrating loads, vibration isolation, blast vibrations, dynamic soil properties, liquefaction potential, vibratory and dynamic compaction, computer implementation. (Lec. 3) Pre: 483 or equivalent. Offered in odd-numbered years. Next offered spring 1995. Kovacs and Veyera

**587 Groundwater Flow and Seepage Pressures** (II, 3) Hydrodynamics of fluid flow through porous media. Analytical methods for steady and unsteady seepage in aquifers; theoretical analysis with practical modification of seepage problems involving foundations, drainage structures, earth dams, and dewatering. (Lec. 2, Lab. 3) Pre: 381 and permission of instructor. Offered in spring of odd-numbered years. Next offered spring 1995. Urish and Kovacs

**588 Groundwater Hydrology** (II, 3) Quantitative methods of groundwater hydrology including determination of aquifer proper-

ties and yield. Modeling of groundwater systems for management quantity of water, movement of contaminants, and well design. Field and laboratory measurements. (Lec. 2, Lab. 3) Pre: MCE 354 and CVE 381 or equivalent. Offered in spring of even-numbered years. Next offered spring 1994. Urish

**591 Special Problems** (I, 1-6) Advanced work under supervision of a staff member arranged to suit individual requirements of the student. Pre: permission of chairperson. (Lec. or Lab. according to nature of problems) Staff

**592 Special Problems** (II, 1-6) Advanced work under supervision of a staff member arranged to suit individual requirements of the student. Pre: permission of chairperson. Staff

**596 Numerical Methods in Structural Engineering** (I or II, 3) Methods of successive approximations and numerical procedures in the solution of stress, vibration, and stability problems in structural members. Nonuniform members, elastic supports, plates, torsion. (Lec. 3) Pre: permission of chairperson. Offered even-numbered years. Next offered spring 1994. Staff

**599 Master's Thesis Research** (I and II) Number of credits is determined each semester in consultation with the major professor or program committee. S/U credit.

**601, 602 Graduate Seminar** (I and II, 1 each) Discussions and presentation of papers based on research or detailed literature surveys. (Lec. 1) Required of all resident graduate students, with a maximum of 1 credit per year allowed. May be repeated for a maximum of 2 credits. Staff

**641 Pavement Evaluation and Rehabilitation** (II, 3) Pavement performance concepts. Criteria for pavement evaluation. Measurement of pavement distress and structural capacity. Analysis and interpretation of pavement evaluation data. Correlation of data with performance ratings. Formulation and evaluation of maintenance and rehabilitation alternatives. (Lec. 3) Pre: 545 or equivalent. Offered spring of odd-numbered years. Next offered spring 1995. Lee

**655 Finite Element Analysis in Civil Engineering II** (I, 3) Isoparametric models for three-dimensional continua, hierarchical elements. Reduced integration concepts, penalty method, discrete Kirchhoff method. Eulerian, total, and updated Lagrangian formulations. (Lec. 3) Pre: 551 or permission of instructor. Offered fall of even-numbered years. Next offered fall 1994. Staff

**657 Structural Stability** (II, 3) Introduction; principal forms of equilibrium paths and their stability; conservative elastic systems; buckling of prismatic members; imperfections; plastic deformations; postbuckling of frames and reticulated structures; numerical methods; catastrophe theory. (Lec. 3) Pre: 556 or permission of instructor. Karamanlidis, McEwen, and Tsiatas

**665 Advanced Topics in Structural**

**Dynamics (I or II, 3)** Equations of motion of systems and continuous bodies; analytical and numerical solution methods; large deflections and plasticity; time-stepping algorithms; active control of tall buildings; earthquake resistant structures; applications. (*Lec. 3*) *Pre: 565. Offered every third year. Next offered spring 1996.* Karamanlidis, McEwen, and Tsiatas

**667 Probabilistic Methods in Structural**

**Engineering (I or II, 3)** Probabilistic applications in structural analysis and design. Statistical models for forces and material strengths. Component and system structural reliability. Random vibration applications in structural engineering. (*Lec. 3*) *Pre: introductory course on probability and 565 or OCE 522, or permission of instructor.* Tsiatas

**668 Theory of Shells**

See Mechanical Engineering 668.

**672 Water Pollution Control and Treat-**

**ment of Wastewater (I or II, 3)** Wastewater characteristics, effects, and purification in natural water, government control strategies and impacts, cost of control, theory and mathematical concepts of secondary and tertiary treatment process, their limitations, and late developments. (*Lec. 3*) *Pre: one year of chemistry and biology, MTH 243 and CVE 572 or their equivalents, and permission of instructor.* Poon

**674 Sanitary Engineering Laboratory**

**(I or II, 3)** Advanced phases of sewage treatment and purification including sludge digestion, sludge gas analysis, biochemical oxygen demand, conditioning of sludge, activated sludge, sewage-trickling filters, and chemical precipitation. (*Lec. 2, Lab. 3*) *Pre: permission of instructor.* Thiem

**677 Stream and Estuarine Analysis**

**(I or II, 3)** Fundamentals and mathematical concepts of physical and biological factors applied to the evaluation of the pollution capacity of streams and estuaries. (*Lec. 3*) *Pre: MTH 244.* Wright

**681 Advanced Geotechnical Engineering I**

**(I or II, 3)** Advanced study of geotechnical principles and theory. Physical and chemical properties of soils; particulate mechanics; effective stress principle; permeability; steady-state and transient seepage; consolidation; stress distribution; miscellaneous topics. (*Lec. 3*) *Pre: 381 or equivalent and permission of instructor.* Kovacs, Silva, and Veyera

**682 Advanced Geotechnical Engineering II**

**(I or II, 3)** Advanced study of geotechnical engineering principles and theory. Stress-strain behavior; constitutive relationships; failure theories; applications of theories of elasticity, viscoelasticity, and plasticity; shear strength of sands; shear strength of clays; slope stability analysis; miscellaneous topics. (*Lec. 3*) *Pre: 381 or equivalent and permission of instructor.* Kovacs, Silva, and Veyera

**687 Geotechnical Earthquake Engineer-**

**ing (I, 3)** Seismology and seismicity; surface faulting and ground motion characteristics; response spectra; dynamic soil properties; dynamic response of soil layers, embankments, and slopes; influence of local soil conditions on site response; evaluation of design earthquakes; response analysis. (*Lec. 3*) *Pre: 483.* Kovacs, Tsiatas, or Veyera

**688 Marine Geomechanics**

See Ocean Engineering 688.

**689 Selected Topics in Geomechanics**

See Ocean Engineering 689.

**691, 692 Special Problems (I and II,**

**1-6 each)** Advanced work under the supervision of a staff member arranged to suit the individual requirements of the student. (*Lec. or Lab. according to nature of problems*) *Pre: permission of chairperson. May be repeated for a maximum of 12 credits.* Staff

**699 Doctoral Dissertation Research**

**(I and II)** Number of credits is determined each semester in consultation with the major professor or program committee. *S/U credit.*

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**Clinical Laboratory Science**

M.S.

401-792-2205

**Graduate Faculty**

*Chairperson:* Professor David C. Laux, Ph.D., 1971, University of Arizona

*Director of Graduate Studies:* Gregory E. Paquette, Ph.D., 1992, University of Rhode Island

Professor Norman A. Campbell, Ph.D., 1972, University of Wisconsin

Professor Albert H. Taubman, Ph.D., 1971, University of Pittsburgh

Professor George C. Tremblay, Ph.D., 1965, St. Louis University

Associate Professor John Boulmetis, Ph.D., 1982, Ohio State University

Associate Professor Jay F. Sperry, Ph.D., 1974, University of Kansas

Adjunct Professor Michael Sheff, Ph.D., 1957, Sheffield University

Adjunct Professor Kurt Stottmeier, Ph.D., 1962, University of Berlin

Adjunct Associate Professor Jacob A. Canick, Ph.D., University of Rhode Island

Adjunct Associate Professor Steven Opal, M.D., 1976, Albany Medical College

Adjunct Assistant Professor Edward Balkovic, Ph.D., 1984, Baylor College of Medicine

Adjunct Assistant Professor Barbara E. Barker, Ph.D., 1965, University of Rhode Island

Adjunct Assistant Professor Julia E. Blazek, Ph.D., 1982, University of Rhode Island

Adjunct Assistant Professor Edward Drozda, M.B.A., 1989, Bryant College

Adjunct Assistant Professor Judith S. Heelan, Ph.D., 1982, University of Rhode Island

Adjunct Assistant Professor Margaret Kenney, M.S., 1983, University of Massachusetts, Dartmouth

Adjunct Assistant Professor Marjorie G. Kimball, M.S., 1981, Northeastern University

Adjunct Assistant Professor Leonard LaFazia, M.S., 1984, Salve Regina University

Adjunct Assistant Professor Anthony J. Lewandowski, M.S., 1985, University of Massachusetts, Dartmouth

Adjunct Assistant Professor Kenneth Mayer, M.D., 1977, Northeastern University

Adjunct Assistant Professor Frank Meglio, M.S., 1980, Northeastern University

Adjunct Assistant Professor Charles Seymour, Ph.D., 1975, Cornell University

Adjunct Assistant Professor Burrows T.

Younkin, Ph.D., 1981, Columbia Pacific University

Professor Emeritus Pei Wen Chang, Ph.D., 1965, Yale University

**Specializations**

Major specializations in clinical chemistry, clinical microbiology, hematology, immunohematology; minor specializations in adult education and management.

**Master of Science**

*Admissions requirements:* GRE recommended; bachelor's degree in medical technology, microbiology, chemistry, or a related area; certification by a nationally recognized certifying agency, as a generalist or a specialist in clinical laboratory science, or a minimum of one year's postbaccalaureate clinical laboratory experience. One course in statistics is required. Applicants with deficiencies in background courses may be required to complete appropriate course work without graduate credit.

*Program requirements:* 33 credits including BCP 551, EDC 505 or 582, MTC 510, 512, 513, and six to nine credits in the area of specialization (ASP 534, MTC 502 and 543 for clinical chemistry; ASP 534, MTC 501, 541 for clinical microbiology; MTC 520, 521, 530 for hematology and immunohematology). The remainder of courses are selected from education and management; also, a course from a technical area other than the declared area is recommended. Comprehensive written examination. Major research paper. The following courses are recommended for a minor specialization in health-care management: PHP 651, 652, 680. These courses are recommended for a minor specialization in adult education: EDC 505, 529, 582, 584.

## MTC Courses Medical Technology

- 401 Clinical Microbiology (I, 8)  
402 Clinical Chemistry (II, 8)  
403 Immunohematology (I, 4)  
404 Hematology (II, 6)  
405 Pathophysiology (I, 2)  
406 Clinical Immunology (II, 2)  
407 Clinical Microscopy (I, 2)  
483 (or MIC 483) Introductory Diagnostic Microbiology (I, 3)

501 (or MIC 501) Advanced Clinical Microbiology I (I or II, 3) Current methodology employed in the processing of clinical microbiology specimens, isolation and identification of pathogenic microorganisms, and determination of antimicrobial susceptibility. (Lec. 3) Pre: 401 or MIC 432 or equivalent. Blazek and Stottmeier

502 Advanced Clinical Chemistry I (I or II, 3) The pathophysiologic mechanisms as they correlate to clinical chemistry data. Topics include mechanisms of pathology and analytical techniques. (Lec. 3) Pre: 402 or equivalent. Canick, Sheff, and Younkin

510 Clinical Laboratory Management (I or II, 3) Supervisory management principles applicable to the clinical laboratory. Includes the processes of supervision, decision making, job performance and evaluation, communications, organizational behavior, and labor relations in the modern laboratory. (Lec. 3) Pre: 400-level medical technology internship or equivalent. Drozda and Williams

512 Special Problems in Clinical Laboratory Science (I or II, 3) Assigned research on an advanced level. Students required to outline problem, conduct the necessary research or experimental work, and present observations and conclusions in a written and oral report. Pre: 400-level medical technology internship or equivalent. Staff

513 (or MIC 513) Advanced Clinical Immunology (I or II, 3) Theory, application, and techniques used in clinical immunology: immunochemistry, serology, immunohematology, immunopathology. (Lec. 3) Pre: 406 or MIC 533 or equivalent. LaFazia and Meglio

520 Advanced Hematology I (I or II, 3) Special problems, advanced techniques, and methodology in hematology; laboratory approach emphasized. (Lec. 3) Pre: 404 or equivalent. Barker

521 Advanced Hematology II (I or II, 3) Hematologic disorders: mechanisms, pathogenesis, diagnosis, and treatment; clinical approach emphasized. (Lec. 3) Pre: 404 or equivalent. Barker

530 Advanced Immunohematology (I or II, 3) Blood grouping and blood banking with emphasis on recent advances. Techniques used for identification of immune disorders, component preparation, tests to determine compatibility. (Lec. 3) Pre: 403 or equivalent. Kenney and Lewandowski

541 (or MIC 541) Advanced Clinical Microbiology II (I or II, 3) Current research and clinical methodology in clinical mycology, parasitology, mycobacteriology, epidemiology, and infectious disease serology. (Lec. 3) Pre: 401 or MIC 432 or equivalent. Blazek and Stottmeier

543 Advanced Clinical Chemistry II (I, II, or SS, 3) A comprehensive study of pathophysiologic mechanisms as they relate to clinical chemistry. Topics include immunochemistry, automation, enzymology, pharmacology, and endocrinology. (Lec. 3) Pre: 402 or equivalent. Canick, Sheff, and Younkin

551 Topics in Biochemistry for the Clinical Scientist  
See Biochemistry and Biophysics 551.

590 Special Problems in Clinical Chemistry (I, II, or SS, 1-6) Intensive tutorial work, research, and readings in clinical chemistry. Pre: graduate standing and permission of chairperson. Staff

591 Special Problems in Clinical Microbiology (I, II, or SS, 1-6) Intensive tutorial work, research, and readings in clinical microbiology. Pre: graduate standing and permission of chairperson. Staff

592 Special Problems in Hematology (I, II, or SS, 1-6) Intensive tutorial work, research, and readings in hematology. Pre: graduate standing or permission of chairperson. Staff

593 Special Problems in Immunohematology (I, II, or SS, 1-6) Intensive tutorial work, research, and readings in immunohematology. Pre: graduate standing and permission of chairperson. Staff

## Community Planning and Area Development

M.C.P.  
401-792-2248

### Graduate Faculty

Chairperson: Professor Marcia Marker Feld, Ph.D., 1973, Harvard University  
Associate Professor Farhad Atash, Ph.D., 1986, Rutgers—The State University  
Associate Professor Marshall M. Feldman, Ph.D., 1981, University of California  
Associate Professor Howard H. Foster, Jr., Ph.D., 1970, Cornell University  
Associate Professor Cynthia M. Hamilton, Ph.D., 1980, Boston University  
Associate Professor Marjorie E. Jensen, M.S., 1978, University of Rhode Island  
Adjunct Professor Carol J. Thomas, M.S., 1948, University of Connecticut  
Adjunct Associate Professor Glenn R. Kumekawa, M.A., 1956, Brown University  
Adjunct Assistant Professor Elizabeth Burke Bryant, J.D., 1985, George Washington University

Adjunct Assistant Professor Patt Manheim, Ph.D., 1984, Cornell University  
Adjunct Assistant Professor Mark Motte, M.C.P., 1986, University of Rhode Island  
Adjunct Assistant Professor Mary Parella, M.C.P., 1989, University of Rhode Island  
Adjunct Assistant Professor Daniel J. Schatz, J.D., 1978, University of Maine  
Adjunct Assistant Professor Robert Shaw, M.S.C.E., 1966, Purdue University  
Adjunct Assistant Professor David S. Winsor, M.C.P., 1980, University of Rhode Island  
Associate Professor Emeritus John J. Kupa, Ph.D., 1966, University of Minnesota

### Specializations

The curriculum educates and trains planners for professional positions in community planning and development agencies in both the public and the private sectors. A core of study in substantive theory and methods relating to urban or urbanizing communities is required. In addition, three specializations are offered: community revitalization planning, public policy and planning, and environmental planning and design.

The specialization in community revitalization planning focuses on urban economic development, with consideration of urban revitalization, urban renewal, and housing. The specialization in public policy and planning differs from the community revitalization specialization in its focus on social planning and social welfare in the urban metropolitan context: it is planning as a public policy process, with emphasis on social services, special populations, and community development. The specialization in environmental planning and design emphasizes the relationship between the built, or human, environment and the natural environment. Concerns for the environmental impacts of development are addressed, combining planning for development with planning for natural resource conservation.

There is also the opportunity for students to choose electives in areas of special interest in community planning and in related departments.

### Master of Community Planning

Admission requirements: GRE, undergraduate background in the social sciences, architecture, landscape architecture, natural resources, engineering, or geography preferred. Competency in social statistics is required and may be demonstrated by having completed an acceptable course at the undergraduate level. Undergraduate courses in computer science and microeconomics are recommended. The degree is accredited by the Planning Accreditation Board and is offered through the New England Regional Program.

*Program requirements:* CPL 510, 512, 522, 523, 526, 630; CPL 501, 511, 525 will also be required unless proficiency has been demonstrated by previous course work; 12 credits in the selected specialization; six credits of thesis, or research project, and a comprehensive examination; summer internship or equivalent experience. The 54-credit program includes 30 credits of core courses with the remaining credits in the elected specialization, free electives, and thesis or project research. Students normally take 12–15 credits per semester to complete studies in two years.

## CPL Courses

### Community Planning

#### 410 Fundamentals of Urban Planning

(II, 3)

#### 434 Introduction to Environmental Law

(II, 3)

**501 Introduction to Community Planning Practice (I, 3)** The development of community planning in the U.S., history of governmental planning and evaluation of the planning profession, and the elements of planning practice. (*Lec. 3*) Foster

**510 Community Planning and Political and Social Change (II, 3)** Introduction to systems and central theories of determinants for social and planned change in urban and urbanizing communities. Focus on methodologies for political and social assessments. (*Sem. 3*) *Pre:* 523 or permission of instructor. Feld

**511 Planning and Natural Environmental Systems (I, 3)** Introduction to theories, methodologies, and substantive concerns of environmental resource analysis with attention given to coastal environmental issues. Focus on land, soils, watersheds, water quality, vegetation, air quality, wildlife, noise pollution. (*Lec. 3*) Staff

**512 Spatial and Fiscal Relationships of Communities (I and II, 3)** The structure and functions of human settlements. Classical and contemporary urban theory. How urbanization and planning influence each other. Emphasizes urbanization as a historical process tied to other social processes. (*Sem. 3*) Feldman

**516 Seminar on the Urban Waterfront**  
See Marine Affairs 516.

**522 Planning Law (I, 3)** General review and discussion of legal principles and thought concerned with property rights, political power, and the legal aspects pertinent to the planning and development of public and private activities. (*Lec. 3*) *Pre:* second-year graduate standing or permission of instructor. Schatz

**523 Planning Theory (I, 3)** Critical survey of planning theories and contemporary planning concepts. Values, assumptions, and processes of various planning paradigms as related to decisions in community planning. Specific emphasis on values and ethics in planning theory. (*Sem. 3*) Feld

**525 Introduction to Planning Methods (I, 3)** Introduction to basic methods in comprehensive and functional area planning. Emphasis on development of manual skills in basic demographic, economic, and land-use projections; project planning management and evaluative techniques. (*Sem. 3*) *Pre:* EST 308 or permission of instructor. Feldman

**526 Planning and Policy Analysis (II, 3)** Quantitative social research methods for planning and master's thesis and applied research papers. Research design, proposals, surveys, sampling, data analysis and decision models for planning. Emphasis on computer methods. (*Sem. 2, Lab. 1*) *Pre:* 525. Feldman

**530 Urban Design and Public Policy (II, 3)** Significant concepts of historical and contemporary urban form ranging from entire cities to architectural details. Emphasis on urban design methods, process, and elements. Alternatives for implementation of urban design projects. (*Lec. 3*) *In alternate years.* Atash

**536 International Comparisons in Urban and Regional Planning (I, 3)** Urban and regional development issues and policies in advanced and developing countries. Emphasis on population growth, urbanization, and spatial development. (*Sem. 3*) *In alternate years.* Atash

**537 (or REN 532) Land Resources Economics (I, 3)** The study of economic relationships of man and scarce natural and man-made resources. Supply and demand, rent theory, resources conservation, and the impact of public policy and law. (*Lec. 3*) Wichelns

**538 Site Planning (II, 3)** Site analysis and planning, including street design, principles of house grouping, and residential subdivision layout. Site planning standards for office development and shopping centers. (*Lec. 2, Lab. 3*) *In alternate years.* Atash

**539 Environmental Law (II, 3)** Analysis of specific environmental issues and policies including facility siting, land use and constitutional issues, comprehensive planning, public trust doctrine, concurrence and state impact assessments. Independent research and presentation required. (*Lec. 3*) Schatz

**541 Urban and Rural Housing Policy (II, 3)** Assessment of urban and rural housing needs; relationship of housing to national economic policy; housing finance; production and cost characteristics; tax policy, filtering and neighborhood change; and housing policy assessments. (*Sem. 3*) *Pre:* 410 or 501 or permission of instructor. *In alternate years.* Feldman

**545 Land Development Seminar (I, 3)** A study of land management techniques including zoning, subdivision regulation, and land suitability and analysis; their use, and environmental implications in land and water development. (*Sem. 3*) *Pre:* 511 or permission of instructor. Staff

**546 (or CVE 546) Urban and Rural Transportation (I, 3)** Issues confronting planning for urban and rural transportation systems; the variety of policies that governments pursue in addressing issues and problems; technical and political constraints, transportation studies, and demand analysis techniques. (*Lec. 3*) *Pre:* 410 or 501 or permission of instructor. *In alternate years.* Shaw and Lee

**549 Seminar in Ecological Planning (II, 3)** Advanced seminar in ecological planning. Topics include hazardous waste, power plant siting, major transportation facilities, solid waste, aquifer protection, among others. Particular emphasis on wetlands and marine and coastal settings. (*Sem. 3*) *Pre:* 511 or permission of instructor. Staff

**589 Master's Project Research (I and/or II, 1–6)** A substantial, self-directed planning project, by one or several students, under guidance of a major professor. Number of credits to be determined each semester. *S/U credit.* Staff

**591, 592 Special Problems in Planning (I or II, 1–6 each)** Individual investigation of special problems in planning. Staff

**593, 594, 595, 596, 597, 598 Special Problems in Planning (I or II, 1–6 each)** Group investigation of special problems in planning. Staff

**599 Master's Thesis Research (I or II, 1–6)** Number of credits is determined each semester in consultation with the major professor or program committee. *S/U credit.* Staff

**624 Planning Policy and Management in Urban Areas (II, 3)** City planning as applied to urban policy in cities and metropolitan areas. Includes social, economic, and physical planning in the context of community development programs and management processes. (*Sem. 3*) *Pre:* 501, 511, 525, or permission of instructor. Foster

**625 Central City Revitalization and Implementation (I, 3)** Advanced concentration course in central city planning. Focus on the problems of central cities and the causes of these problems. Emphasis on government policies to deal with the problems of the inner city. (*Sem. 3*) *Pre:* 624 or permission of instructor. Foster

**630 Comprehensive Planning Studio (II, 6)** Applied team problem solving. Planning experience working with specific client and/or community emphasizing sequential process and group product. Project to include problem definition, conceptual design analysis, and oral/graphic presentations. (*Studio 6*) *Pre:* 501, 511, 523, 525, or permission of instructor. Foster

**631 Advanced Planning Studio (I, 6)** Team projects in planning and design; research and program development; field studies and problem analysis in local and state contexts. Development and evaluation of alternative solutions. (*Studio/Sem.*) *Pre:* 630 or permission of instructor. Atash

**691, 692 Special Problems in Planning** (*I or II, 1–6 each*) Advanced work under the supervision of a staff member arranged to suit the individual requirements of the student. Staff

**693, 694 Special Problems** (*I or II, 1–6 each*) Advanced work under the supervision of a staff member arranged to suit the requirements of a group of students. Staff

## Comparative Literature Studies

M.A.  
401-792-5911

### Graduate Faculty

*Coordinator:* Professor John R. Leo, Ph.D., 1972, Northwestern University

#### Department of English

Professor Lois Cuddy, Ph.D., 1975, Brown University

Professor Wilfred P. Dvorak, Ph.D., 1972, Indiana University

Professor Daniel D. Pearlman, Ph.D., 1968, Columbia University

Professor Ralph M. Tutt, Ph.D., 1966, Duke University

Assistant Professor Jean Walton, Ph.D., 1989, State University of New York, Buffalo

#### Department of Languages

(French) Associate Professor Ira A. Kuhn, Ph.D., 1970, University of Kansas

(French—Linguistics) Professor Kenneth H. Rogers, Ph.D., 1970, Columbia University

(Italian) Professor Paschal Viglionese, Ph.D., 1969, Rutgers—The State University

(Portuguese) Professor Gregory R. McNab, Jr., Ph.D., 1973, New York University

(Russian) Professor Sona Aronian, Ph.D., 1971, Yale University

(Spanish) Professor Robert Manteiga, Ph.D., 1977, University of Virginia

(Spanish) Associate Professor Thomas D.

Morin, Ph.D., 1975, Columbia University

(Spanish) Associate Professor Mario Trubiano, Ph.D., 1979, University of Massachusetts

### Specializations

English language literatures (American, British, Irish, Scots), Classical, French (including Quebecois and Black French literature), German, Italian, Portuguese, Russian, and Hispanic literatures.

### Master of Arts

*Admission requirements:* B.A. degree; formal training or demonstrable competence in literature; high level of proficiency in one foreign language.

*Program requirements:* first literature, nine credits; second literature, six credits (one of the literatures may be English); CLS 510; electives pertinent to a student's program of study to be approved by the major

professor and advisory committee; reading knowledge of a second foreign language; comprehensive examination; thesis option—thesis and 24 credits; nonthesis option—30 credits, including six credits of independent study resulting in the production of extended essays.

### CLS Courses

#### Comparative Literature Studies

**450 Studies in Comparative Literature** (*I or II, 3*)

**510 Introduction to Comparative Literature** (*I or II, 3*) Theoretical and practical concerns of comparative literature: its nature and scope, methods, bibliography, and special problems. (*Lec. 3*) *Pre: graduate standing or permission of chairperson.* Viglionese

**520 Literary Theory and Criticism**

(*I or II, 3*) Metacriticism: literary criticism as theory and practice and the relationship between literary and critical discourse.

(*Lec. 3*) *Pre: graduate standing or permission of chairperson. May be repeated once with change of topic.* Staff

**530 Approaches in Comparative Literature**

(*I or II, 3*) Study of theme/myth, movement/era, genre/forms in two or more literatures, or interrelations with other disciplines.

(*Lec. 3*) *Pre: graduate standing or permission of chairperson. May be repeated once with change of topic.* Staff

**597 Special Problems** (*I and II, 1–6*) Group and/or individual investigation of special problems in comparative literature studies. Staff

**599 Master's Thesis Research** (*I and II, 1–6*)

Number of credits is determined each semester in consultation with the major professor and the Comparative Literature Studies Advisory Committee. Staff

See other listings under English and Modern and Classical Languages and Literatures.

## Computer Science

M.S.  
401-792-2701

### Graduate Faculty

*Chairperson:* Associate Professor Edmund A. Lamagna, Ph.D., 1975, Brown University

*Director of Graduate Studies:* Professor Gerard M. Baudet, Ph.D., 1978, Carnegie Mellon University

Professor Edward J. Carney, Ph.D., 1967, Iowa State University

Associate Professor Frank M. Carrano, Ph.D., 1969, Syracuse University

Associate Professor James G. Kowalski, Ph.D., 1975, University of Notre Dame

Associate Professor Bala Ravikumar, Ph.D., 1987, University of Minnesota

Assistant Professor Joan Peckham, Ph.D., 1990, University of Connecticut

Assistant Professor Victor Wolfe, Ph.D.,

1991, University of Pennsylvania

Adjunct Associate Professor Charles R.

Arnold, Ph.D., 1976, Harvard University

Adjunct Associate Professor Charles M.

Strauss, Ph.D., 1967, Brown University

Adjunct Assistant Professor Robert V. Rubin, Ph.D., 1988, Brown University

### Specializations

Analysis of algorithms, artificial intelligence, computer architecture, programming languages, theory of computation, databases, operating systems, distributed computing, expert systems, graphical user interfaces, software engineering, symbolic and algebraic computation, VLSI systems, numerical analysis, statistical computation, simulation, computer-aided education.

### Master of Science

*Admission requirements:* bachelor's degree, including undergraduate training in computer science at least through the syntax and semantics of a variety of programming language types, machine and assembly language concepts, fundamentals of data structures and algorithms. Mathematics through linear algebra, calculus of several variables, and discrete mathematics. GRE, including advanced test in computer science. Applicants may submit, if they so desire, additional advanced GRE scores for consideration.

*Program requirements for thesis option:* 1) a minimum of 24 credits (exclusive of thesis) and a thesis; 2) at least 15 credits must be earned at the 500 level or above; 3) at least 18 credits must be from computer science courses; 4) completion of at least six credits in one of the following areas and three credits in each of the other two: architecture and systems—CSC 511, 512, 517; mathematical foundations—CSC 541, 542, 544; programming languages—CSC 501, 502.

*Program requirements for nonthesis option:* 1) a minimum of 30 credits, including at least one course with a substantial paper involving significant independent research; 2) at least 21 credits must be earned at the 500 level or above; 3) at least 24 credits must be from computer courses; 4) completion of at least six credits in each of two of the following areas and three credits in the third: architecture and systems—CSC 511, 512, 517; mathematical foundations—CSC 541, 542, 544; programming languages—CSC 501, 502; 5) passing a written comprehensive examination.

### Doctor of Philosophy

See Applied Mathematical Sciences on page 28.

## CSC Courses Computer Science

- 402 Compiler Design (I, 3)  
 406 Computer Graphics (II, 3)  
 411 Computer Organization (I, 3)  
 412 Operating Systems (II, 3)  
 420 Software Engineering (II, 3)  
 436 Database Management Systems (I, 3)  
 440 Design and Analysis of Algorithms I (I, 3)  
 445 Formal Languages and Automata Theory (II, 3)  
 447 (or MTH 447) Discrete Mathematical Structures (I, 3)  
 450 Fundamentals of Numerical Computation (II, 3)  
 481 Artificial Intelligence (II, 3)  
 491 Directed Study in Computer Science (I and II, 1-3)  
 492 Special Topics in Computer Science (I or II, 3)

501 Programming Language Semantics (I, 3) Design, analysis, implementation, and comparative study of major programming language families. Topics include procedural and block-structured languages, interpretive languages, concurrency, functional languages, object-oriented programming, logic programming, dataflow languages and machines. (Lec. 3) Pre: 301 and 311. Staff

502 Theory of Compilers (II, 3) An advanced course in compiler construction covering advanced parsing techniques, compiler-writing tools, type checking and type inference, code optimization, and compiling nonstandard language features. (Lec. 3) Pre: 402. In alternate years. Next offered spring 1995. Staff

511 Advanced Computer Organization (I, 3) Evaluation of high-performance computer systems with respect to architectures, operating systems, and algorithms. High-speed conventional machines; array processors; multiprocessors; data flow machines; RISC architectures; VLSI-based machines. (Lec. 3) Pre: 411. In alternate years. Next offered fall 1993. Staff

512 Topics in Operating Systems (II, 3) In-depth studies of topics chosen from the following list: concurrent programming, computer systems performance, and distributed systems. (Lec. 3) Pre: 412. In alternate years. Next offered spring 1994. Staff

517 Design and Analysis of VLSI Systems (I, 3) Illustration and analysis of VLSI algorithms and architecture. Emphasis on design of very large-scale integrated circuits, related methodologies, and theoretical foundations. VLSI technologies, fabrication, automated design tools for various problems. (Lec. 3) Pre: 411 and 340 or 447. In alternate years. Next offered fall 1994. Staff

525 (or IME 525) Simulation (II, 3) Discrete simulation models. Comparison of discrete change simulation languages. Methodology including generation of random variates, design of simulation experiments for opti-

mization and validation of models and results. Selected applications. Pre: 212 and 6 credits of statistics. Staff

541 Design and Analysis of Algorithms II (I, 3) Advanced topics in the design and analysis of algorithms including combinatorial optimization and graph algorithms; computational geometry; primality and factoring, public-key cryptography; minimal comparison sorting; size and delay in switching circuits. (Lec. 3) Pre: 440. In alternate years. Next offered fall 1995. Staff

542 Mathematical Analysis of Algorithms (I, 3) Mathematical techniques for the analysis of algorithms. Sums and products; finite difference calculus; properties of binomial coefficients; Stirling, harmonic, and Fibonacci numbers; recurrence relations; generating functions; asymptotic approximation. Case studies. (Lec. 3) Pre: 440. In alternate years. Next offered fall 1994. Staff

544 Theory of Computation (II, 3) Automata and formal languages; undecidability; time and space complexity classes and relations between them; hierarchy and gap theorems; Savitch's theorem; alternating Turing machines; the complexity class NC. (Lec. 3) Pre: 340 or 447. In alternate years. Next offered spring 1994. Staff

547 Combinatorics and Graph Theory  
 See Mathematics 547.

548 Topics in Combinatorics  
 See Mathematics 548.

550 Advanced Numerical Computation (II, 3) Design of efficient numerical algorithms under various models of computation. Topics include polynomial and integer computations, computational linear algebra with applications to combinatorial optimization, lower bounds. (Lec. 3) Pre: 450. In alternate years. Next offered spring 1995. Staff

581 (or ELE 581) Special Topics in Artificial Intelligence (II, 3) Topics of specialized or current interest, which may change. Topics may include expert systems, natural language processing, neural network models, machine learning. AI applications in remote sensing. (Lec. 3) Pre: 481 or permission of instructor. May be repeated with permission. In alternate years. Next offered spring 1994. Staff

583 Computer Vision  
 See Electrical Engineering 583.

591 Directed Study in Computer Science (I and II, 1-3) Advanced work in computer science conducted as supervised individual projects. Pre: permission of chairperson. S/U credit. Staff

592 Special Topics in Computer Science (I or II, 3) Advanced topics of current interest in computer science. (Lec. 3) Pre: permission of chairperson. Staff

599 Master's Thesis Research (I and II) Number of credits is determined each semester in consultation with the major professor or program committee. S/U credit.

## Economics

See Resource Economics on page 100.

## Economics—Marine Resources (Interdepartmental)

Ph.D. in Economics—Marine Resources

See Resource Economics on page 100.

## Education

M.A.  
 401-792-2564

### Graduate Faculty

Chairperson: Professor Theodore Kellogg, Ph.D., 1971, Florida State University  
 Director of Graduate Studies: Professor Robert W. MacMillan, Ph.D., 1966, University of Texas, Austin

### Adult Education

Professor William Croasdale, Ed.D., 1966, Teachers College, Columbia University  
 Professor Theodore Kellogg, Ph.D., 1971, Florida State University  
 Professor Robert W. MacMillan, Ph.D., 1966, University of Texas, Austin  
 Associate Professor John Boulmetis, Ph.D., 1982, Ohio State University  
 Associate Professor Richard G. Nelson, Ph.D., 1972, University of Wisconsin

### Educational Research

Professor John V. Long, Jr., Ph.D., 1971, Syracuse University  
 Professor Richard F. Purnell, Ph.D., 1966, University of Texas

### Elementary Education

Associate Professor Richard E. Sullivan, Ph.D., 1971, University of Texas, Austin  
 Associate Professor Susan L. Trostle, Ed.D., 1984, Pennsylvania State University  
 Assistant Professor Alora Valdez, Ph.D., 1992, University of Arizona  
 Assistant Professor Betty Young, Ph.D., 1989, University of California, Los Angeles

### Reading Education

Associate Professor Susan L. Trostle, Ed.D., 1984, Pennsylvania State University  
 Assistant Professor James F. Barton, Ph.D., 1990, Stanford University  
 Professor Emeritus Marguerite Bumpus, Ed.D., 1969, University of Massachusetts

### Science Education

Professor William Croasdale, Ed.D., 1966, Teachers College, Columbia University  
 Professor Theodore M. Kellogg, Ph.D., 1971, Florida State University

### Secondary Education

Professor Barbara Brittingham, Ph.D., 1973, Iowa State University  
 Professor William Croasdale, Ed.D., 1966, Teachers College, Columbia University  
 Professor John V. Long, Jr., Ph.D., 1971, Syracuse University  
 Professor William L. McKinney, Ph.D., 1973, University of Chicago  
 Professor Francis X. Russo, Ph.D., 1964, Boston University  
 Professor George H. Willis, Ph.D., 1971, The Johns Hopkins University  
 Associate Professor David M. Byrd, 1980, Syracuse University  
 Associate Professor Richard G. Nelson, Ph.D., 1972, University of Wisconsin

Enrollment of foreign students is limited; minimum TOEFL score of 600 is required.

The Master of Arts degree is offered in the following areas of study. Applicants should specify the area of specialization on the application form.

### Adult Education

*Admission requirements:* MAT or GRE, a baccalaureate degree from an accredited institution, and an interview with program faculty.

*Program requirements:* thesis or nonthesis option. Thirty-three credits, including 12 credits of core courses (EDC 505, 529, 583 and 584), 15 credits of electives structured into either a predefined subspecialization area or a unique subspecialization area designed in conjunction with the student's advisor. Predefined subspecializations include administration, adult literacy, Education, Training, and Management (ETMS), gerontology, training and development, and vocational-technical and extension education. The Education, Training, and Management (ETMS) subspecialization is designed for U.S. naval officers who wish to obtain the ETMS "P" code designation. Thesis or nonthesis seminar. Nonthesis option requires written comprehensive examination.

### Educational Research

*Admission requirements:* MAT or GRE, instructional experience, strong background in mathematics or statistics.

*Program requirements:* thesis; 33 credits, including EDC 503, 529, 574, PSY 434, 520, one computer science and two experimental statistics electives.

### Elementary Education

*Admission requirements:* MAT or GRE and teaching certificate, one year teaching experience or equivalent desirable.

*Program requirements:* thesis or nonthesis option. EDC 529, 21–24 credits including three credits of foundations, three credits of

methods, three credits of free electives, six credits of thesis or nonthesis seminar, and three to six credits taken outside the Department of Education. Nonthesis option requires written comprehensive examination.

### Reading Education

*Admission requirements:* MAT or GRE and teaching certificate, one year teaching experience or equivalent desirable.

*Program requirements:* thesis or nonthesis option. EDC 503, 529; 24 credit hours of courses approved for the preparation of reading specialists, including a thesis or six credit hours of clinic or practicum experience, and one or more electives. Nonthesis option requires written comprehensive examination.

### Science Education

*Admission requirements:* MAT or GRE and teaching certificate, undergraduate major in science, interview with faculty.

*Program requirements:* 30 credits, including EDC 529; 12–18 credits of education electives, including six credits of thesis or nonthesis seminar and a minimum of 12 credits in science. Nonthesis option requires a written comprehensive examination.

### Secondary Education

*Admission requirements:* MAT or GRE and teaching certificate, one year's teaching experience desirable, undergraduate major in academic area of secondary education, interview with faculty.

*Program requirements:* thesis or nonthesis option. Thirty credits, including EDC 529; three credits of foundations; 6–12 credits of education, including six credits for thesis or nonthesis seminar and a minimum of 12 credits in the academic area. Nonthesis option requires the written comprehensive examination.

For Teacher Certification, see page 106.

### EDC Courses Education

- 401 Development and Utilization of Instructional Materials (I and II, 3)
- 402 The Education of Special Needs Students (I and II, 3)
- 403 History of Education (I, 3)
- 407 Philosophy of Education (I and II, 3)
- 410 Seminar and Supervised Field Practicum in Education of the Aging (I and II, 3)
- 424 Teaching of Reading (I and II, 3)
- 425 The Use of Trade Books in the Reading Program (I, 3)
- 435 (or WRT 435) The Teaching of Composition (I and II, 3)
- 448 Reading in the Content Areas (I, 3)
- 449 Teaching Adolescent Literature (I, 3)
- 478, 479 Problems in Education (I and II, 0–3 each)

### 500 Foundations of Adult Education

(I and II, 3) Examination of fundamental structure, functions, problems, and history of adult education in America. Focus on socioeconomic factors and philosophical commitments that have shaped various programs. (Lec. 3) *Pre: graduate or senior standing and permission of instructor.* Russo and Boulmetis

### 502 The Modern Curriculum Movement

(I, 3) Development of recent thinking of American curriculumists. The nature of curriculum development analyzed through the traditionalist, social scientific, and reconceptualist schools of thought. (Lec. 3) Willis

### 503 Education in Contemporary Society

(II, 3) Leading educators' responses to issues and challenges confronting American education. Emphasis on identification and analysis of contemporary theories and practices reflecting the relationship between characteristics of society and educational values. (Lec. 3) Russo and Willis

### 504 Adult Basic Education (I and II, 3)

Teaching of adults whose educational level is below high school completion. Physical, social, and psychological characteristics of disadvantaged adults and various techniques and materials useful in motivating and teaching them. (Lec. 3) *Pre: permission of instructor.* Staff

### 505 Leadership Development in Adult Programs (I or II, 3)

Discussion of leadership concepts, styles, and implications. Discussion and practice in the use of several adult education methods and techniques for increasing the effectiveness of groups and organizations. *Pre: permission of instructor.* Staff

### 508 Interdisciplinary Curriculum

Development (I, II, or SS, 3) Curriculum development of interdisciplinary units for elementary and middle schools. Focus is on grade-level units which incorporate multiple subject areas. Both individual and group projects required. (Lec. 3) *Pre: teacher certification.* Staff

### 509 Critique of Public Policy in Human Services and Education (I and II, 3)

Use of ideological assumptions in formulating and developing interpretive, normative, and critical perspectives on recent public policy proposals in various areas of human services and education. (Lec. 3) *Pre: permission of chairperson.* Willis and Russo

### 514 Current Trends in Elementary Education (I, 3)

For teachers and administrators, the most effective use of instructional materials, media of communication, and personnel in elementary school. (Lec. 3) *Pre: 529 or permission of chairperson. In alternate years. Next offered 1993–94.* Staff

### 515 Discipline and Youth in Schools

(I or II, 3) Seminar for teachers interested in classroom principles and techniques from research on discipline in public secondary schools. Will include dramatic role-playing by participants when feasible. (Lec. 3) *Pre: teacher certification or permission of instructor.* Purnell

**516 Teaching English as a Second Language to Adults (II, 3)** Methods and materials for educators who teach English as a second language to adults. (Lec. 3) Pre: permission of instructor. Staff

**517 Teaching Social Studies in the Elementary School (I, II, or SS, 3)** Intensive research in various cross-subject topics within the social studies. Systematic analyses of learning theories and methods as they relate to the teaching of social studies in the elementary grades. (Lec. 3) Pre: graduate or postgraduate standing. MacMillan

**518 Teaching Science in the Elementary School (I or II, 3)** Emphasis on the development, preparation, use, and evaluation of materials appropriate for the elementary classroom from biology, zoology, chemistry, physics, geology, astronomy, electricity, meteorology, and oceanography. Pre: 12 credits in science. Staff

**520 Teaching of Arithmetic (I, 3)** For the experienced teacher, examination of the principles underlying teaching of arithmetic in the elementary school, comprehensive survey of materials and methods available for the classroom teacher of arithmetic. (Lec. 3) Pre: senior or graduate standing. In alternate years. Next offered 1994-95. Staff

**521 Teaching Basic Reading to Adults (I or II, 3)** Techniques for teaching basic reading skills to illiterate adults; diagnosis, methods, and materials. (Lec. 3) Pre: 504 or permission of instructor. Staff

**522 Microcomputer Applications in the Classroom (I and II, 3)** Introduction to the use of microcomputers in elementary and secondary classrooms. History, current use, techniques for evaluating hardware and software, implementation issues, future developments. (Lec. 3) Pre: senior or graduate standing. Staff

**528 Teaching Language Arts (II, 3)** For the elementary school classroom teacher. Preparation, presentation, use, and evaluation of methods and materials for teaching the communications skills (emphasis on listening, speaking, and writing). (Lec. 3) Pre: senior or graduate standing. In alternate years. Next offered 1994-95. Staff

**529 Foundations of Educational Research (I and II, 3)** Analysis of the current major research approaches to educational problems with emphasis on interpreting published research involving the language of statistics. Functional skills in basic descriptive statistics needed prior to enrolling. (Lec. 3) Purnell

**530 Qualitative Research and Evaluation (I or II, 3)** Qualitative methods, including ethnography, for obtaining and using data in describing, interpreting, and reaching warranted judgments, particularly about educational and social problems. Emphasis on developing individual projects and writing formal reports. (Lec. 3) Pre: permission of instructor. Willis

**531 School-Home Relations (I or II, 3)** Seminar for school personnel, developmentalists, and family and community specialists interested in principles and techniques from research on school-home relations. (Sem. 3) Pre: permission of instructor or teacher certification. Purnell

**534 Mathematics in the Secondary School (II, 3)** Implementation of a modern mathematics program in the secondary school through a study of modern mathematics concepts, experimental programs, and instructional planning. (Lec. 3) Pre: 15 credits in mathematics. Croasdale

**535 Classroom Observation and Evaluation (I or II, 3)** Practicum in informal, naturalistic methods of observing and evaluating classrooms. Designed to increase teachers' and administrators' understanding of their own and others' classrooms in fostering individual and staff professional development. (Lec. 2, Lab. 2) Pre: teaching experience, eligibility for teacher certification, or permission of instructor. Willis

**538 Teaching the Gifted and Talented (I or II, 3)** Social, psychological, legal, and educational issues related to identification, selection, and instruction of gifted and talented students. (Lec. 3) Pre: one undergraduate general psychology course, graduate standing, or permission of instructor. Sullivan

**539 Evaluation and Monitoring of Occupational Training Programs (I or II, 3)** Evaluation and monitoring theory and practice for occupational training programs. Focus on development of systems for job training such as CETA, Vocational Education, and private sector programs. (Lec. 3) Pre: 529 or permission of instructor. Boulmetis

**540 Learning Disabilities: Assessment and Intervention**  
See Psychology 540.

**561 Analysis of Reading Disabilities (I, 3)** Causes of reading difficulties and the administration of diagnostic reading tests. Emphasis on construction and use of informal tests and standardized measures. Practice in analyzing data from case histories and in making individual case studies. (Lec. 3, Lab. 2) Pre: 424 and permission of instructor. Staff

**562 Techniques in Remedial Reading (II, 3)** Practices effective in teaching remedial reading in both the regular classroom and remedial clinics. Analysis of published materials. Methods of building new materials, discussion and demonstration of their practical application. (Lec. 3, Lab. 2) Pre: 561 and permission of instructor. Staff

**563 Teaching Reading to Multicultural Populations (I, 3)** Identification of the strengths of learners whose cultural and socioeconomic backgrounds vary, and the implications for teaching reading. Special emphasis on the selection and development of appropriate materials and teaching strategies. (Lec. 3) Pre: 424 or permission of instructor. Staff

**565 Analysis and Evaluation of Current Research in Reading (I, 3)** In-depth review of reading research on selected topics. Analysis of findings in historical perspective. Implications for reading teachers and reading programs. (Sem. 3) Pre: 424 or permission of instructor. In alternate years. Next offered 1993-94. Staff

**566, 567 Practicum in Reading (I and II, 3 each)** Supervised case studies, practicum, and seminar reports on an individual reading project at either the elementary or secondary level. (120 hours plus seminar) (Lec. and/or Lab. 3) Pre: 562 and permission of instructor. Staff

**569 Middle School Curriculum (SS, 3)** Current middle school curriculum organization and materials with emphasis on the flexibility and integration of various content areas. (Lec. 3) Pre: graduate standing. Staff

**570 Elementary School Curriculum (II, 3)** Modern curriculum in the elementary school with emphasis on the needs of children. Covers language arts, social studies, science, arithmetic, and special subjects. (Lec. 3) Pre: 503, 529 or equivalent. In alternate years. Next offered 1993-94. Staff

**571 The Secondary School Curriculum (II, 3)** Intensive study of basic principles and procedures utilized in developing curriculum materials. Emphasis given to content of all curriculum areas in junior and senior high schools. (Lec. 3) Pre: 503 and 529. In alternate years. Next offered 1994-95. Staff

**572 Cooperative Supervision (I and II, 3)** Analysis of function, principles, and techniques of democratic cooperative supervision of teachers and other school officials. Application of these principles to supervisory problems of principals, heads of departments, special supervisors, and critic teachers. (Lec. 3) Staff

**574 Current Trends in Secondary Education (I and II, 3)** Effective use of instructional materials, media of communication, and organization of personnel and current research. Pre: 529, 571 or permission of chairperson. Staff

**575 Supervised Field Study/Practicum and Seminar in Education (I and II, 3 each)** For nonthesis candidates. Lectures, seminars, and field work. Candidates plan and conduct a field study/practicum project approved by the instructor and the student's professor. A formal proposal is developed, submitted, and approved, the project completed, and a formal paper defended. Pre: admission to a master's program in education and permission of instructor. May be repeated for a maximum of 6 credits. Staff

**577 Organization and Administration in Elementary School (I, 3)** Functions and duties of elementary school principals. (Lec. 3) In alternate years. Next offered 1993-94. Staff

**579 Labor Relations and Collective Bargaining in Education**  
See Labor Studies 579.

**581 Administering Adult Programs**

(I or II, 3) Administration, personnel management, resource management, recruitment, staff development, and supervision within programs dealing with adults as learners. (Lec. 3) *Pre: 505 or permission of instructor. Staff*

**582 Instructional Systems Development for Adult Programs** (I, 3) Designing and implementing instructional systems. Discussion of the basic tenets underlying theories of instructional technology, curriculum development, and curriculum change as they apply to adult learners in a variety of settings. (Lec. 3) *Pre: 580 or 581 or permission of instructor. Staff*

**583 Planning, Design, and Development of Adult Learning Systems** (I, 3) Overview of the program planning process including goal setting, needs analysis, program planning, and implementing change strategies. Discussion of effective functioning in the role of change agent within an organization. (Lec. 3) *Pre: permission of instructor. Staff*

**584 The Adult and the Learning Process** (I and II, 3) Examination of the adult as a learner with emphasis on the factors that affect adult learning and learning processes related to instruction. (Lec. 3) *Pre: 581 or permission of instructor. Staff*

**585 Seminar on Leadership for Youth and Adult Programs** (II, 3) Students will participate in a nonstructured group to observe the emergence of leadership and the effects of individual behavior on the self and others. (Lec. 3) *Pre: graduate standing in education and permission of instructor. Staff*

**586, 587 Problems in Education** (I and II, 0-3 each) Advanced work for graduate students in education. Courses conducted as seminars or as supervised individual projects. (Lec. or Lab.) *Pre: permission of chairperson. May be repeated for credit with different topic. Staff*

**593 Teaching Social Studies in the Secondary School** (I, II, or SS, 3) Research and examination of the structure, functions, and problems of teaching social studies in the secondary school. Emphasis on researching current social problems as they relate to their historical antecedents. (Lec. 3) *Pre: teacher certification or permission of instructor. MacMillan*

**594 Organization and Supervision of Reading Programs** (II, 3) Various roles of the reading specialist in relation to the other line-staff personnel. Problems concerning the orientation of new teachers, reading research and development, inservice programs, and community support. (Lec. 3) *Pre: 562. In alternate years. Next offered 1993-94. Staff*

**596 Organization Development in Education**  
See Human Development and Family Studies 562.

**599 Master's Thesis Research** (I and II)  
Number of credits is determined each semester in consultation with the major professor or program committee. *S/U credit.*

**920 Workshop for Teachers** (I and II, 1-3)  
Current issues in education. Specific topics offered for inservice teachers and administrators. May be repeated with different topic. (Lec. or Lab.) *Pre: teacher certification. Staff*

**ADE Courses****Adult and Extension Education**

**488 Methods and Materials for Adult Extension Education** (I and II, 3)

**491, 492 Special Problems in Adult Education** (I and II, 1-3 each)

**RDE Courses****Resource Development Education**

**444 (or EDC 444) Teaching Agribusiness and Natural Resources** (I, 3)

**Electrical Engineering**

M.S., Ph.D.  
401-792-2505

**Graduate Faculty**

*Chairperson:* Professor William Ohley, Ph.D., 1976, State University of New York, Stony Brook

*Director of Graduate Studies:* Associate Professor Peter F. Swaszek, Ph.D., 1982, Princeton University

Professor G. Faye Boudreaux-Bartels, Ph.D., 1983, Rice University

Professor James C. Daly, Ph.D., 1967, Rensselaer Polytechnic Institute

Professor Leland B. Jackson, Sc.D., 1970, Stevens Institute of Technology

Professor Steven M. Kay, Ph.D., 1980, Georgia Institute of Technology

Professor Ramdas Kumaresan, Ph.D., 1982, University of Rhode Island

Professor Gabriel Lengyel, Ph.D., 1964, University of Toronto

Professor Allen G. Lindgren, Ph.D., 1962, University of Connecticut

Professor Shmuel Mardix, Ph.D., 1969, University of Jerusalem

Professor Shashanka S. Mitra, Ph.D., 1957, University of Michigan

Professor Angaraih G. Sadasiv, Ph.D., 1963, Purdue University

Professor John E. Spence, Ph.D., 1962, University of Wisconsin

Professor Harish R.B. Sunak, Ph.D., 1974, University of Southampton

Professor Donald W. Tufts, Sc.D., 1960, Massachusetts Institute of Technology

Professor Richard J. Vaccaro, Ph.D., 1983, Princeton University

Associate Professor Godi Fischer, Ph.D.,

Swiss Federal Institute of Technology in the Institute of Telecommunications

Associate Professor Ying Sun, Ph.D., 1985, Worcester Polytechnic Institute

Associate Professor Qing Yang, Ph.D., 1988, University of Southwestern Louisiana

Assistant Professor Jen-Chung Lo, Ph.D., 1989, University of Southwestern Louisiana

Adjunct Associate Professor Pranab K. Banerjee, Ph.D., 1971, University of Rhode Island

Adjunct Assistant Professor David O. Williams, M.D., 1969, Hahnemann Medical College

Professor Emeritus Charles Polk, Ph.D., 1956, University of Pennsylvania

**Specializations**

*Acoustics and underwater acoustics:* information processing in acoustic channels, speech processing, modeling of electroacoustical devices.

*Biomedical engineering:* physiologic systems modeling and control; medical instrumentation employing digital computer techniques, pattern recognition and image processing in medicine (texture analysis, image classification, and segmentation); biological effects of electric and magnetic fields at the cellular level.

*Computer engineering and VLSI:* microprogramming systems, multiprocessing, high-speed signal processing; processor realization using VLSI; MOS layout and microchip design; data structures and computer architectures, fault-tolerant computing.

*Communication theory:* statistical and computer communications; vector quantization; noise modeling and detection; data compression and coding; local area networks, reliable and secure communication.

*Digital signal processing:* detection and parameter estimation; prediction and filtering; spectrum analysis; array processing; digital filter synthesis; adaptive filtering, algorithm design.

*Electrical and optical properties of materials:* optical properties of nonmetallic solids, laser-matter interaction, photocathodes; crystallographic techniques for submicron X-ray lithography; radiation damage in nonmetallic solids.

*Electromagnetic fields and optical communication:* numerical and approximate methods for calculation of electromagnetic fields in inhomogeneous and anisotropic structures (related to biological effects of electromagnetic fields); evaluation of mode characteristics in optical and infrared waveguides.

*Systems theory:* control and estimation theory; multivariable systems; nonlinear systems, modeling of deterministic and stochastic systems; model order reduction; optimal smoothing, filtering, and prediction; computerized imaging systems and image analysis.

### Master of Science

*Admission requirements:* GRE and M.S. degree in electrical or computer engineering, engineering science, physics, mathematics, or computer science; exceptional students with a Bachelor of Science degree will be considered.

*Program requirements:* qualifying examination may be waived for students with a master's degree. A minimum of 72 credits beyond the B.S. degree, 18–24 of which are dissertation credits (a master's degree may count for up to 30 credits). A comprehensive examination taken after all formal course work is completed. Attendance at the departmental seminar (ELE 601, 602) is required of all students in graduate residence. Dissertation research makes use of major modern laboratories in the listed areas of specialization.

### Doctor of Philosophy

*Admission requirements:* GRE and M.S. degree or equivalent in electrical engineering, engineering science, physics, mathematics, or computer science.

*Program requirements:* Qualifying examination may be required. A minimum of 42 credits beyond the M.S. degree, 18–24 of which are course credits. The other 18–24 are dissertation credits. A comprehensive examination taken after all formal course work is completed. Attendance at the departmental seminar (ELE 601, 602) is required of all students in graduate residence. Dissertation research makes use of major modern laboratories in the listed areas of specialization.

### ELE Courses

#### Electrical Engineering

- 401 Lasers, Optical Systems, and Communications (I, 4)
  - 405 Digital Computer Design (II, 3)
  - 408 Computer Organization Laboratory (II, 4)
  - 427 Electromechanical Systems Laboratory (I, 4)
  - 432 Electrical Engineering Materials (II, 4)
  - 436 Communication Systems (I, 4)
  - 437 Computer Communications (II, 3)
  - 443 Electronics II (I, 5)
  - 444 Advanced Electronic Design (II, 4)
  - 447 VLSI Design and Simulation (II, 4)
  - 457 Feedback Control Systems (I, 3)
  - 458 Digital Control Laboratory (II, 4)
  - 482 Biomedical Engineering Seminar I, II (I and II, 1 each)
  - 491, 492, 493 Special Problems (I and II, 1 each)
  - 495 Electrical Engineering Practice I (I, II, or SS, 3)
  - 501 Linear Transform Analysis (I, 3)
- Fourier and Laplace transform analysis of continuous-time systems, causality and spectral factorization, evaluation of inverse transforms, z-transform analysis of discrete-time systems, Hilbert transforms, discrete

Fourier transforms, generalized transforms. (Lec. 3) Staff

#### 502 Nonlinear Control Systems (II, 3)

Analysis of nonlinear systems: phase-plane analysis, Lyapunov theory, advanced stability theory, describing functions, design of nonlinear control systems: feedback linearization, sliding control. (Lec. 3) Pre: 503 or permission of instructor. Staff

#### 503 (or MCE 503) Linear Control Systems (I or II, 3)

State-variable description of continuous-time and discrete-time systems, matrices and linear spaces, controllability and observability, pole-placement methods, observer theory and state reconstruction, modern control systems design. (Lec. 3) Pre: 313 or MCE 366 or equivalent. Staff

#### 504 (or MCE 504) Optimal Control Theory (II, 3)

Quadratic performance indices and optimal linear control, frequency response properties of optimal feedback regulators, state estimation, separation theorem, optimal control of nonlinear systems, Pontryagin's minimum principle. (Lec. 3) Pre: 503. Staff

**506 Digital Signal Processing (II, 3)** Digital representations of signals and noise; sampling and aliasing; design of digital-processing systems for signal parameter estimation and signal detection; digital filter structures; discrete Fourier transform and FFT algorithm, periodogram. (Lec. 3) Pre: 501 and 509. Staff

#### 509 Systems with Random Inputs (I or II, 3)

Discrete and continuous linear systems with random inputs. Introduction to random processes in the context of linear systems. Applications to detection, smoothing, and prediction. (Lec. 3) Pre: knowledge of differential equations, linear systems, and transform methods. Staff

**510 Communication Theory (II, 3)** Communication theory for discrete and continuous channels. Optimum-receiver principles and signal design. Channel models, modulation techniques, data compression, speech and image coding, architecture and topology of communication networks. (Lec. 3) Pre: 509. Staff

**511 Engineering Electromagnetics (I, 3)** Review of electrostatics and magnetostatics. Maxwell's equations, wave propagation in dielectric and conducting media. Boundary phenomena. Radiation from simple structures. Relations between circuit and field theory. (Lec. 3) Staff

**515 Quantum Electronics (I or II, 3)** Laser engineering and applications, interaction of radiation with atoms, optical resonators, electro-optic modulation, harmonic generation, parametric oscillation and frequency conversion, noise in laser amplifiers and oscillators. (Lec. 3) Pre: PHY 341 or permission of instructor. Staff

**525 Fiber Optic Communication Systems (II, 3)** Survey of important topics in optical communication devices and systems. The

physical principles and operation of lasers, LEDs, fibers, and detectors are covered. (Lec. 3) Pre: 323, 331, 401 or equivalent. Lengyel

**526 Fiber Optic Sensors (II, 3)** Theory and performance of different types of intensity-, phase-, and polarization-modulated fiber optic sensors (FOS) and their application areas. Properties of various active and passive devices used in building FOS. (Lec. 3) Pre: 401 or equivalent. Sunak

**527 Current Topics in Lightwave Technology (I, 3)** Current topics of importance in lightwave technology including coherent fiber optical communication systems, optical amplifiers, active and passive single-mode devices, infrared optical fibers. Material will be taken from recent literature. (Lec. 3) Pre: 525 or equivalent. Sunak

#### 531 Solid State Engineering I (I or II, 3)

Review of quantum mechanics, crystal properties, energy-band theory, introduction to scattering, generation-recombination processes, Boltzmann's transport equation, semiconductor junctions, devices. (Lec. 3) Pre: 331 or equivalent. Staff

#### 532 Solid State Engineering II (I or II, 3)

Properties of insulators, semiconductors, conductors, and superconductors from quantum mechanical principles. Semiconductor physics and band theory of solids as applied to current semiconductor and optoelectronic devices. (Lec. 3) Pre: 531 or equivalent. Staff

#### 536 Semiconductor Electronics (I or II, 3)

Theory and technology of semiconductor devices. Junction, field effect, optoelectronic and microwave devices. Integrated circuits. (Lec. 3) Pre: 331 or equivalent. Sadasiv

**537 VLSI System Design (I or II, 3)** Very large-scale integration. Silicon technology; NMOS, CMOS, and bipolar devices; circuits, and digital subsystems; computer-aided design and analysis of VLSI circuits; VLSI and digital system architecture. (Lec. 3) Pre: graduate standing or senior standing with permission of instructor. Sadasiv

**538 Principles of Remote Sensing (I or II, 3)** Theory and techniques of remote sensing including spaceborne photometry and radiometry. Applications selected from the following topics: planetary atmospheres, geology and earth resources, environmental problems. (Lec. 3) Pre: 323, PHY 406, or permission of instructor. Staff

**539 Analog VLSI (I or II, 3)** Theory and techniques of analog MNOS and CNOS integrated circuits. Device modeling, circuit simulation, and chip design are studied using amplifiers, A/Ds, and switched-capacitor circuits as examples. (Lec. 3) Pre: 537. Daly

**542 Fault-Tolerant Computing (I or II, 3)** Fault and error modeling, reliability modeling and evaluation, fault-tolerant computer systems, digital and mixed analog/digital VLSI testing, concurrent error detection, and design for VLSI yield enhancement. (Lec. 3) Pre: 405 or equivalent or permission of instructor. Staff

**544 Computer Arithmetic for VLSI (II, 3)** Review of number systems and computer arithmetic: hardware implementation of fixed- and floating-point adders, multipliers and dividers; VLSI implementation of residue arithmetic finite fields; error analysis and time/gate complexity of arithmetic operations. (Lec. 3) *Pre:* 405. Kumaresan

**545 Design of Digital Circuits (I, 3)** Design techniques for digital computers and controllers. Combinatorial and sequential circuits, minimization techniques, fast arithmetic circuits, memory and control circuits, floating-point hardware, Turing machines, coders and decoders, microprogramming, sequence generators. (Lec. 3) *Pre:* 405 or equivalent. Staff

**546 Computer-Based Instrumentation (I, 3)** Design of memory systems, input-output techniques, direct memory access controllers, instrument buses, video displays, multiprocessors-coprocessors, real-time operations, device handler integration into high-level language and mass storage. (Lec. 2, Lab. 3) *Pre:* 205, 314, and concurrent enrollment in 405. Ohley and Sun

**548 Computer Architecture (I or II, 3)** Classification and taxonomy of different computer architectures. Pipelining and RISC machines, vector and array processors, multiprocessors, dataflow computers. Cache memory and virtual memory systems, and multiprocessor algorithms. (Lec. 3) *Pre:* 405. Staff

**549 Computer System Modeling (I, 3)** Basic techniques used in computer system modeling, queueing theory, stochastic processes, Petri net, product form networks, approximation techniques, solution algorithms and complexity, computer simulation, performance studies of modern computer systems. (Lec. 3) *Pre:* 548 and 509 or concurrent enrollment in MTH 451. Staff

**571 Underwater Acoustics I**  
See Ocean Engineering 571.

**575 (or MTH 575) Approximation Theory and Applications to Signal Processing (II, 3)** Interpolation; uniform approximation; least squares approximation; Hilbert space; the projection theorem; computation of best approximations; applications to the design of filters and beamformers, position location and tracking, signal parameter estimation. (Lec. 3) *Pre:* advanced calculus, elements of the theory of functions of a complex variable, and elements of linear algebra. Staff

**581 Special Topics in Artificial Intelligence**  
See Computer Science 581.

**582 Robotics (I or II, 3)** Description, design, and control of industrial and research robots. Tactual and visual sensing systems. Computer control of manipulators. Object descriptions for manipulation. Obstacle avoidance. Applications. (Lec. 3) *Pre:* knowledge of matrix algebra and Laplace transforms or permission of instructor. Staff

**583 (or CSC 583) Computer Vision (I, 3)** Algorithms used to extract information from two-dimensional images. Picture functions. Template matching. Region analysis. Contour following. Line and shape descriptions. Perspective transformations. Three-dimensional reconstruction. Image sensors. Interfacing. Applications. (Lec. 3) *Pre:* MTH 362 or equivalent. Staff

**584 (or EST 584) Pattern Recognition (II, 3)** Random variables, vectors, transformations, hypothesis testing, and errors. Classifier design: linear, nonparametric, approximation procedures. Feature selection and extraction: dimensionality reduction, linear and nonlinear mappings, clustering, and unsupervised classification. (Lec. 3) *Pre:* 509, CSC 410 or introductory probability and statistics, and knowledge of computer programming. Staff

**588 Biomedical Engineering (I, 3)** Modeling of biosystems. Electrical properties of biological materials. Electrocardiography, vectorcardiography. Models of nerve propagation. (Lec. 3) *Pre:* ZOO 345 or equivalent, knowledge of differential equations, senior or graduate standing. Staff

**591, 592 Special Problems (I and II, 1–3 each)** Advanced work under supervision of a staff member arranged to suit individual requirements of student. *Pre:* graduate standing. May be repeated for a maximum of 6 credits. Staff

**599 Master's Thesis Research (I and II)** Number of credits is determined each semester in consultation with the major professor or program committee. *S/U credit.*

**601, 602 Graduate Seminar (I and II, 1 each)** Seminar discussions including the presentation of papers based on research or detailed literature surveys. (Lec. 1) *Required of all resident graduate students with a maximum of 1 credit per year allowed. May be repeated for a maximum of 2 credits. S/U credit. Staff*

**606 Digital Filter Synthesis (I, 3)** Review of z-transforms and discrete-time systems, properties of digital-filter networks, design of finite and infinite-impulse-response filters, accuracy considerations for coefficients and data, hardware implementation, system examples. *Pre:* 506 or equivalent. Jackson

**625 Guided Waves in Optical and IR Fibers (I, 3)** Guided electromagnetic wave aspects of optical and IR fibers, novel approximation methods for solution of vectorial and scalar wave equations in optical fibers, theory of transparency and nonlinear optical interactions in solids as applied to design of optical fibers. (Lec. 3) *Pre:* 511 and 525. Mitra

**630 Advanced Topics in Solid State (I or II, 3)** Seminar for advanced students. Selected topics of current research interest. Material will be drawn primarily from recent literature. (Lec. 3) *Pre:* 531, 532, or permission of instructor. Staff

**651 Feedback Control Systems (I, 3)** Analysis of synthesis of complex control systems. Extension of feedback control theory to handle random disturbances, sampled data, and nonlinearities. System optimization. (Lec. 3) *Pre:* 457 or equivalent. Staff

**660 Advanced Topics in System Theory (I or II, 3)** Seminar for advanced students. Selected topics of current research interest. Material will be drawn primarily from recent literature. (Lec. 3) *Pre:* permission of instructor. Staff

**661 Estimation Theory (I or II, 3)** Extraction of information from discrete and continuous data, best linear estimation, recursive estimation, optimal linear filtering, smoothing and prediction, nonlinear state and parameter estimation, design and evaluation of practical estimators. (Lec. 3) *Pre:* 503 and 509. Staff

**665 Modulation and Detection (I or II, 3)** Advanced treatment of modulation and detection theory. Minimum meansquare error, maximum likelihood, and maximum posterior probability estimators. Applications to communications systems and to radar and sonar systems. (Lec. 3) *Pre:* 510. Kay or Tufts

**670 Advanced Topics in Signal Processing (I or II, 3)** Seminar for advanced students. Selected topics of current research interest. Material will be drawn primarily from recent literature. (Lec. 3) *Pre:* 506 and 606. Staff

**672 Underwater Acoustics II**  
See Ocean Engineering 672.

**677 Statistical Sonar Signal Processing**  
See Ocean Engineering 677.

**691, 692 Special Problems (I and II, 1–3 each)** Advanced work under supervision of a staff member arranged to suit individual requirements of a student. *Pre:* permission of chairperson. May be repeated for a maximum of 6 credits. *S/U credit. Staff*

**699 Doctoral Dissertation Research (I and II)** Number of credits is determined each semester in consultation with the major professor or program committee. *S/U credit.*

## English

M.A., Ph.D.  
401-792-5931

## Graduate Faculty

*Chairperson:* Professor Wilfred P. Dvorak, Ph.D., 1972, Indiana University  
*Director of Graduate Studies:* Professor Karen F. Stein, Ph.D., 1982, University of Connecticut  
Professor Walter L. Barker, Ph.D., 1966, University of Connecticut  
Professor Josie P. Campbell, Ph.D., 1972, Pennsylvania State University  
Professor Lois Cuddy, Ph.D., 1975, Brown University

Professor Dorothy F. Donnelly, Ph.D., 1979,  
Brandeis University  
Professor Don R. Kunz, Ph.D., 1968,  
University of Washington  
Professor John R. Leo, Ph.D., 1972,  
Northwestern University  
Professor Allan H. MacLaine, Ph.D., 1951,  
Brown University  
Professor Francis X. Mathews, Ph.D., 1964,  
University of Wisconsin  
Professor Richard T. Neuse, Ph.D., 1959,  
Yale University  
Professor Daniel D. Pearlman, Ph.D., 1968,  
Columbia University  
Professor Robert A. Schwegler, Ph.D., 1977,  
University of Chicago  
Professor Jules P. Seigel, Ph.D., 1965,  
University of Maryland  
Professor Ralph M. Tutt, Ph.D., 1966, Duke  
University  
Associate Professor Paul G. Arakelian, Ph.D.,  
1975, Indiana University  
Associate Professor Sally F. Burke, Ph.D.,  
1978, University of Connecticut  
Associate Professor Walter Cane, Ph.D.,  
1966, Vanderbilt University  
Associate Professor Mathilda M. Hills, Ph.D.,  
1970, Duke University  
Associate Professor Dorothy Jacobs, Ph.D.,  
1968, University of Michigan  
Associate Professor Celest A. Martin, Ph.D.,  
1979, University of Southern California  
Associate Professor Thomas H. McCabe  
Ph.D., 1968, University of Wisconsin  
Associate Professor RB Reaves, Jr., Ph.D.,  
1971, University of Wisconsin  
Associate Professor Eric T. Schoonover,  
A.M., 1959, University of Michigan  
Associate Professor Linda Shamoan, M.A.,  
1967, Tufts University  
Associate Professor M. Beverly Swan, Ph.D.,  
1977, Boston University  
Assistant Professor Mary Cappello, Ph.D.,  
1988, State University of New York,  
Buffalo  
Assistant Professor Gitahi Gititi, Ph.D.,  
1990, University of Minnesota  
Assistant Professor William L. Mensel, Jr.,  
Ph.D., 1974, University of Washington  
Assistant Professor F.E. Okeke-Ezigho, Ph.D.,  
1979, State University of New York,  
Buffalo  
Assistant Professor Nedra Reynolds, Ph.D.,  
1991, University of Miami, Ohio  
Assistant Professor Dana R. Shugar, Ph.D.,  
1991, University of Iowa  
Assistant Professor Susan Vaughn, M.A.,  
1966, Miami University, Ohio  
Professor Emerita Nancy A. Potter, Ph.D.,  
1954, Boston University; L.H.D., 1967,  
University of Rhode Island  
Professor Emerita Edna L. Steeves, Ph.D.,  
1948, Columbia University  
Associate Professor Emerita Marilyn J.  
Malina, Ph.D., 1967, University of  
Virginia

## Specializations

*For the M.A. and for the Ph.D.:* all historical periods, genres, and major authors in British and American literature; Scots and Irish literature; critical theory; rhetoric and composition studies.

## Master of Arts

*Admission requirements:* a minimum of 21 credits in English or related courses with a quality point average of B (3.00 on a 4.00 scale) or better in all English courses. Applicants with diverse academic backgrounds are encouraged to apply. Completed application packages are to be sent directly to the Director of Graduate Studies, English Department, University of Rhode Island, Independence Hall, and must be received by January 15. Applicants will be accepted for September admission only. Nonnative speakers of English must have a minimum score of 630 on the TOEFL in order to be considered for admission.

*Program requirements:* 24 credits plus thesis (6 credits); OR 30 credits (including two 600-level seminars) plus a comprehensive examination based on a departmental reading list and a course requiring a substantial paper involving significant independent study. The specialization in rhetoric and composition studies requires WRT 512, 535 and ENG 680, 681.

## Doctor of Philosophy

The Doctor of Philosophy program is small and selective. Admission is competitive and based mainly on academic merit, demonstrated capability to do research, and the match of research interests between the applicant and faculty in indicated or developing areas of specialization.

*Admission requirements:* M.A. in English or equivalent. Although grades are not the only criterion, applicants having less than a 3.30 quality point average (on a 4.00 scale) have a low probability for admission. Completed application packages should be sent to the Director of Graduate Studies, English Department, University of Rhode Island, Independence Hall, and must be received by January 15. Applicants will be accepted for September admission only. Applications received by January 15 will be given a full review; applications received after that deadline, but before July 15, will be reviewed on a space-available basis until the program is filled. Nonnative speakers of English must have a minimum score of 630 on the TOEFL in order to be considered for admission. Applicants with diverse academic backgrounds are encouraged to apply.

*Program requirements:* 24 credits (including a minimum of four 600-level courses) plus 18 credits of dissertation research. Three written comprehensive examinations: one in the area of specialization (i.e., disser-

tation); one on critical methodology; and the third in a geographical or historical area substantially different from the specialization or dissertation area(s). Oral examination based on the dissertation proposal. For specialization in rhetoric and composition studies, WRT 512, 535 and ENG 680, 681 are required. A limited number of 500- and 600-level courses in other departments and programs may be used for program credit if approved as part of the student's program of study before the courses are taken. (In some cases, a research tool may be required by a student's doctoral committee in consultation with the Director of Graduate Studies.)

## Financial Aid

All requests for tuition waivers, assistantships, and fellowships should be sent to the Director of Graduate Studies. In addition to teaching assistantships, there is an editorial graduate assistantship for the journal *ATQ: American Transcendental Quarterly*. Complete applications for assistantships must be received by January 15.

## ENG Courses English

445 *Ethnic Images in American Literature* (II, 3)

446 *Modern Drama* (I and II, 3)

447 *Modern British and American Poetry* (I and II, 3)

448 *Traditions of the American Novel* (I and II, 3)

458 *Traditions of the British Novel* (I and II, 3)

468 *Traditions of the Continental Novel* (I and II, 3)

469 *The Modern Novel* (I and II, 3)

472 *Shakespeare's Plays* (I and II, 3)

474 (or AAF 474) *Topics in Pan-African Literature* (II, 3)

477 *Traditions of British Drama* (I and II, 3)

485 *American Authors* (I or II, 3)

486 *British Authors* (I or II, 3)

510 *Bibliography and Literary Research* (I or II, 3) Use of descriptive and analytical bibliography, various modes of literary criticism, and other scholarly tools in the solution of literary research problems. (Lec. 3) *Pre: graduate standing or permission of instructor. Next offered spring 1994. Steeves*

530 *History of the English Language* (I, 3) Historical study of development of English syntax, sounds, vocabulary, and usage. (Lec. 3) *Pre: graduate standing or permission of instructor. Next offered fall 1993. Arakelian*

531 *History of Critical Theory* (I, 3) Important critical theories from Aristotle to the twentieth century. Emphasis on orientation of theories to various aspects of the literary situation. Some study of modern attitudes toward earlier critics. (Lec. 3) *Pre: senior or graduate standing or permission of instructor. Next offered fall 1993. Staff*

**532 Modern Literary Criticism (I, 3)** Dominant modes and schools of criticism exemplified by T.S. Eliot, T.E. Hulme, I.A. Richards, Edmund Wilson, John Crowe Ransom, and other important critics. Pertinent related literary works. (Lec. 3) *Pre: graduate standing or permission of instructor. Next offered fall 1993.* Staff

**534 Structure of the English Language (I or II, 3)** Synchronic study of American morphology, phonology, and syntax, and the application of linguistic methodology to the teaching and analysis of literature and composition. (Lec. 3) *Pre: graduate standing or permission of instructor. Next offered spring 1995.* Arakelian

**535 Old English (II, 3)** Introduction to the language and literature. (Lec. 3) *Pre: graduate standing or permission of instructor. Next offered spring 1994.* Mensel

**536 Problems in Linguistics and Literature (I or II, 3)** Recent developments in linguistics and their application to the study of literature. (Lec. 3) *Pre: graduate standing or permission of instructor. Next offered fall 1994.* Staff

**540 Modern American Novel (I, 3)** Important American novelists of the twentieth century with emphasis on major developments in ideas and techniques. (Lec. 3) *Pre: graduate standing or permission of instructor. Next offered fall 1993.* Staff

**545 Problems in American Realism and Naturalism (I, 3)** Readings, discussions, and papers on stylistic, thematic, and philosophic issues relating to literary artists like Howells, James, Crane, Dreiser, Hemingway, and others. (Lec. 3) *Pre: graduate standing or permission of instructor. Next offered spring 1995.* Staff

**546 Problems in American Romanticism (I, 3)** Major themes and works of such authors as Poe, Emerson, Thoreau, Hawthorne, Melville, Whitman, and others. (Lec. 3) *Pre: graduate standing or permission of instructor. Next offered fall 1993.* Staff

**547 Early American Literature to 1800 (II, 3)** Thorough examination of colonial and federal literature, some discussion of beginnings of Romanticism. Special attention to Taylor, Edwards, Franklin, Freneau, and Charles Brockden Brown. (Lec. 3) *Pre: graduate standing or permission of instructor. Next offered spring 1994.* Towers

**549 Modern American Poetry (I or II, 3)** In-depth study of several major American poets, such as Eliot, Pound, Frost, Stevens, Williams, and others; or of a school such as the Imagists, the Fugitives, and others. (Lec. 3) *Pre: graduate standing or permission of instructor. Next offered spring 1995.* Staff

**550 Middle English Literature (I or II, 3)** Selections from Middle English literature exclusive of Chaucer. Works by Malory, the Pearl Poet, Gower, the Wakefield Master, and others. (Lec. 3) *Pre: graduate standing or permission of instructor. Next offered fall 1994.* MacLaine

**551 The Metaphysical Poets (I, 3)** Intensive analysis and interpretation of poetry of Donne, Herbert, Vaughan, Crashaw, and Marvell. (Lec. 3) *Pre: graduate standing or permission of instructor. Next offered spring 1995.* Staff

**554 Modern British Poetry (I, 3)** In-depth study of several major British poets, such as Yeats, Lawrence, Auden, Thomas, MacNeice, and others; or of a school such as the War Poets (WW I), and others. (Lec. 3) *Pre: graduate standing or permission of instructor. Next offered fall 1994.* Staff

**555 Modern British Novel (I, 3)** Important British novelists of the twentieth century with emphasis on major trends in ideas and techniques. (Lec. 3) *Pre: graduate standing or permission of instructor. Next offered fall 1994.* Mensel

**556 English Literature of the Sixteenth Century (II, 3)** Early humanism. Tudor poetry and its continental antecedents. Satire and translation. Elizabethan voyage literature. Writers chosen from More, Erasmus, Skelton, Wyatt, Surrey, Sidney, Spenser, Marlowe, Hakluyt, Lodge, Shakespeare, and others. (Lec. 3) *Pre: graduate standing or permission of instructor. Next offered fall 1994.* Staff

**557 English Literature of the Seventeenth Century (I, 3)** Selected poets and prose writers, studied for their contribution to the dominant themes and modes of expression of the Stuart and Cromwellian eras. (Lec. 3) *Pre: graduate standing or permission of instructor. Next offered fall 1994.* Jacobs

**558 English Literature of the Eighteenth Century (II, 3)** Intensive study of major and selected minor figures of the eighteenth century. Emphasis on verse and nonfiction prose, some attention to developments of the drama. (Lec. 3) *Pre: graduate standing or permission of instructor. Next offered fall 1994.* Staff

**559 English Literature of the Romantic Period (I, 3)** Selections from the major works and writers of the Romantic Movement. (Lec. 3) *Pre: graduate standing or permission of instructor. Next offered spring 1995.* Staff

**560 English Literature of the Victorian Period (II, 3)** Selections from the major works and writers of the Victorian period. (Lec. 3) *Pre: graduate standing or permission of instructor. Next offered spring 1995.* Dvorak

**561 Modern European Novel (II, 3)** Major developments in the European novel during the twentieth century. Special attention to Proust, Mann, Kafka, Moravia, Silone, Lagerkvist, Malraux, and Camus. (Lec. 3) *Pre: graduate standing or permission of instructor. Next offered fall 1993.* Staff

**570 Anglo-Irish Writers (II, 3)** The Celtic Renaissance as a literary movement, its importance and influence. AE, Lady Gregory, Joyce, O'Casey, O'Flaherty, Stephens, Synge, Yeats, and others. (Lec. 3) *Pre: graduate standing or permission of instructor. Next offered spring 1995.* Staff

**571 Problems in Chaucer (II, 3)** Intensive study of selected aspects of Chaucer's achievements as a poet. Emphasis on *The Canterbury Tales*. (Lec. 3) *Pre: graduate standing or permission of instructor. Next offered fall 1993.* Staff

**573 Problems in Shakespeare (II, 3)** Primarily a discussion course, concentrating on plays and characters that offer most interesting problems for student analysis. Solutions by leading critics are examined. (Lec. 3) *Pre: permission of instructor. Next offered fall 1994.* Staff

**574 The Scots' Poetic Tradition Through Robert Burns (II, 3)** Intensive study of the poetry of Robert Burns, Ferguson, Ramsay, and others who sparked the Scottish revival. (Lec. 3) *Pre: graduate standing or permission of instructor. Next offered spring 1995.* Staff

**575 Modern Southern Literary Renaissance (II, 3)** Comprehensive study of a major literary movement. Representative works by Faulkner, Wolfe, Warren, Williams, Porter, Welty, O'Connor, and others. (Lec. 3) *Pre: graduate standing or permission of instructor. Next offered spring 1995.* Tutt

**576 English Novel of the Eighteenth Century (II, 3)** Selected novels of Defoe, Richardson, Fielding, Smollett, Sterne, and Austen, with consideration of major criticism and of disparate influences on the emergence of the novel. (Lec. 3) *Pre: graduate standing or permission of instructor. Next offered spring 1995.* Reaves

**577 English Novel of the Nineteenth Century (II, 3)** Important British novelists of the nineteenth century with emphasis on trends in ideas and techniques of Victorian novelists. (Lec. 3) *Pre: graduate standing or permission of instructor. Next offered fall 1993.* Staff

**578 Problems in Milton (II, 3)** Emphasis on the major poetic works. (Lec. 3) *Pre: graduate standing or permission of instructor. Next offered spring 1995.* Staff

**580 Selected Topics in Women and Literature (I or II, 3)** Selected topics in literature by and about women. (Lec. 3) *Pre: graduate standing or permission of instructor.* Staff

**590 Selected Topics (I and II, 3)** Selected topics in American and British literature and topics of special interest not covered by traditional department offerings. (Lec. 3) *Pre: graduate standing or permission of instructor. Next offered spring 1994.* Staff

**599 Master's Thesis Research (I and II)** Number of credits is determined each semester in consultation with the major professor or program committee. *S/U credit.*

*The 600-level (seminar) courses include: specialized topics, intensive readings, occasional lecture, and frequent presentation of ongoing research by students. A substantial research project and permission of the chairperson are required.*

**640, 641 Seminar in American Literature Before 1900** (*I or II, 3 each*) Staff

**643 Seminar in Modern Literature (American)** (*I or II, 3*) Staff

**650, 651 Seminar in English Literature of the Middle Ages** (*I and II, 3 each*) Staff

**652 Seminar in English Literature of the Sixteenth Century** (*I or II, 3*) Staff

**655 Seminar in English Literature of the Seventeenth Century** (*I or II, 3*) Staff

**656, 657 Seminar in English Literature of the Eighteenth Century** (*I and II, 3 each*) Staff

**658 Seminar in English Literature of the Nineteenth Century** (*I or II, 3*) Staff

**660, 661 Seminar in Modern Literature (English)** (*I and II, 3 each*) Staff

**670, 671 Seminar in Special Literary Problems** (*I and II, 3 each*) Readings in literature which present special problems not addressed by traditional department offerings. Seminar topics may be offered from time to time based on student request. (*Lec. 3*) Staff

**680, 681 Seminar in Special Rhetorical Problems** (*I and II, 3 each*) Readings in rhetoric which present special problems not addressed by traditional department offerings. Seminar topics may be offered from time to time based on student request. (*Lec. 3*) *Pre: graduate standing or permission of instructor. Next offered spring 1995.* Staff

**691, 692 Independent Graduate Study** (*I and II, 3 each*) Advanced study of an approved topic under the supervision of a staff member. (*Lec. 3*) *Pre: permission of chairperson.* Staff

**699 Doctoral Dissertation Research** (*I and II*) Number of credits is determined each semester in consultation with the major professor or program committee. *S/U credit.*

## WRT Courses Writing

**435 (or EDC 435) The Teaching of Composition** (*I and II, 3*)

**512 Modern Rhetorical Theory** (*I, 3*) An introduction to theories of rhetoric and their relation to literature and language. Includes D'Angelo, Kinneavy, Winterowd, Perelman, Booth, and Burke. Pertinent related literary works. (*Lec. 3*) *Pre: graduate standing or permission of instructor. Next offered fall 1993.* Staff

**535 Theories and Strategies in the Teaching of Writing** (*II, 3*) An introductory course in theories and pedagogy of rhetoric. Readings and lectures cover the current research in composition, including such areas as ESL and business or technical communications. (*Lec. 3*) *Pre: graduate standing or permission of instructor. Next offered spring 1994.* Staff

**999 Methods of Teaching College Writing** (*I and II, 0*) Materials and multiple methods of teaching writing on the college level. Required of teaching assistants who will teach in the College Writing Program unless waived by the Director of English Graduate Studies, the supervisor of teaching assistants, and the Director of the College Writing Program. Staff

## Entomology

M.S.  
401-792-2792

### Graduate Faculty

*Chairperson:* Professor Richard J. Hull, Ph.D., 1964, University of California  
*Director of Graduate Studies:* Assistant Professor Joe Chandlee, Ph.D., 1984, North Carolina State University  
Professor Richard A. Casagrande, Ph.D., 1975, Michigan State University  
Professor Roger A. LeBrun, Ph.D., 1977, Cornell University  
Associate Professor Steven R. Alm, Ph.D., 1985, Ohio State University  
Associate Professor Patrick A. Logan, Ph.D., 1978, Michigan State University  
Associate Professor Thomas N. Mather, Ph.D., 1983, University of Wisconsin  
Adjunct Associate Professor Howard S. Ginsberg, Ph.D., 1979, Cornell University

### Specializations

*Entomology:* insect ecology, pest management, aquatic entomology, and biology and ecology of disease-transmitting arthropods.

*Plant protection:* integrated pest management, plant-insect interactions, and biological control.

### Master of Science

*Admission requirements:* GRE and undergraduate major in biological, agricultural, or physical sciences. Fundamental courses in biological sciences, mathematics, and chemistry may be required to make up deficiencies without graduate credit.

*Program requirements:* course work as determined by graduate committee, three departmental seminars which include a final thesis seminar, and a thesis.

For courses, also see listing under Plant Sciences.

## ENT Courses Entomology

**550 Insect Morphology and Systematics** (*I, 3*) External morphology of insects and taxonomy of major families. (*Lec. 2, Lab. 2*) *Pre: 385. In alternate years. Next offered fall 1994.* Logan

**529 (PLS) Systems Science for Ecologists** (*I, 3*) Concepts and techniques for computer analysis and simulation of complex biological systems. (*Lec. 3*) *Pre: PLS 141, BOT 262, or permission of instructor.* Logan

**533 (PLS) Graduate Writing in Life Sciences** (*II, 3*) Graduate writing skills for the life and environmental sciences; writing and editing journal articles, proposals; rhetorical analysis of scientific writing. (*Lec. 2, Lab. 2*) *Pre: WRT 101 or equivalent or permission of instructor. Graduate standing or senior status.* Logan and Vaughn

**555 (PLS) Insect Pest Management** (*II, 3*) Evaluation of past and present pest-control strategies in light of insect ecology. Development of pest-management systems emphasizing biological control, resistant plants, and ecosystem redesign. (*Lec. 3*) *Pre: 200 or ENT 385 or permission of instructor.* Casagrande

**561 (PLS) Aquatic Entomology** (*I, 3*) Biology of insects in aquatic environments, including systematics, morphology, and ecology. Field trips emphasize relations between species and habitat and the role of insects in aquatic management programs. (*Lec. 2, Lab. 3*) *Pre: 385 or permission of instructor.* LeBrun and Logan

**571 (PLS) Insect Microbiology** (*II, 3*) A two-part investigation of insect-microbe associations, concentrating on the comparative pathobiology of microbial agents in the insect host and the transmission of plant disease organisms by the insect vectors. (*Lec. 3*) *Pre: PLS 381 and MIC 211, or permission of instructor. In alternate years. Next offered 1994-95.* LeBrun

**591, 592 Special Problems in Entomology** (*I and II, 1-3 each*) Advanced independent research projects supervised by members of the research staff and unrelated to thesis research. Projects developed to meet individual needs. *Pre: permission of chairperson.* Staff

**599 Master's Thesis Research** (*I and II, 1-6*) Number of credits determined each semester in consultation with the major professor or program committee. *S/U only.* Staff

## Experimental Statistics

See Statistics on page 105.

## Fisheries, Animal and Veterinary Science

M.S., Ph.D. (Biological Sciences)  
401-792-2487

### Graduate Faculty

*Chairperson:* Associate Professor Murn M. Nippo, Ph.D., 1976, University of Rhode Island

*Director of Graduate Studies:* Associate Professor Richard C. Rhodes, Ph.D., 1980, Texas A&M University  
 Professor Richard E. Wolke, Ph.D., 1968, University of Connecticut  
 Associate Professor Terence M. Bradley, Ph.D., 1983, University of Idaho  
 Associate Professor Joseph T. DeAlteris, Ph.D., 1986, College of William and Mary  
 Associate Professor Conrad W. Recksiek, Ph.D., 1972, University of Maine  
 Associate Professor Michael A. Rice, Ph.D., 1987, University of California, Irvine  
 Assistant Professor Ulysses G. Whitworth, D.V.M., 1976, Tuskegee Institute  
 Adjunct Associate Professor Joel Bodammer, Ph.D., 1974, University of Wisconsin  
 Adjunct Associate Professor Michael W. Fleming, Ph.D., 1980, Ohio State University  
 Adjunct Associate Professor Grace Klein-MacPhee, Ph.D., 1979, University of Rhode Island  
 Adjunct Associate Professor Jan Pechenik, Ph.D., 1978, University of Rhode Island  
 Adjunct Assistant Professor David Berlinsky, Ph.D., 1989, University of Rhode Island  
 Professor Emeritus Pei Wen Chang, Ph.D., 1965, Yale University

## MASTER OF SCIENCE

### Specializations

#### ANIMAL AND VETERINARY SCIENCE

*Animal science:* regional, national, and global problems are studied in the areas of animal behavior, endocrinology, nutrition, physiology, and reproductive biology. Both domestic livestock and laboratory animals are used in a research context.

*Animal health and disease:* animal health problems of regional, national, and global significance are studied. Bacterial and viral diseases are characterized, and the contributions of stress and pathologic conditions to disease are considered.

#### FISHERIES AND AQUACULTURE

*Aquaculture:* aquaculture of salmonids and shellfish; genetics, nutrition, and physiology of fishes.

*Fisheries:* fisheries science and technology.

*Aquatic pathology:* pathology of aquatic animals; effects of environmental pollution on aquatic organisms.

### Admission Requirements

GRE and an undergraduate major in the biological sciences with a concentration in animal science, fisheries technology, marine biology, microbiology, preveterinary medicine, or zoology, or postgraduate professional degrees (M.D., D.V.M., V.M.D.); one year of organic chemistry and physics. Courses in statistics, histology, and physiology are strongly recommended.

### Program Requirements

#### ANIMAL AND VETERINARY SCIENCE

*Animal science:* thesis and 24 credits of course work to include two semesters of graduate seminar, ASP 501 and/or 502; ASP 532; AVS 412, 472. Thesis topic and additional course work will be selected by the student after consultation with, and approval of, the major professor.

*Animal health and disease:* thesis and 24 credits of course work to include two semesters of graduate seminar, ASP 501 and/or 502; ASP 401, 532, 534. Thesis topic and additional course work will be selected by the student after consultation with, and approval of, the major professor.

#### FISHERIES AND AQUACULTURE

*Fisheries:* thesis and 24 credits of course work to include two semesters of graduate seminar, ASP 501 and/or 502; two courses in statistics (at least one at the 500 level); FST 415, 421. A total of 14 credits of ASP or FST course work must be included in the program of study. Thesis topic and additional course work will be selected by the student after consultation with, and approval of, the major professor.

*Aquaculture:* thesis and 24 credits of course work to include two semesters of graduate seminar, ASP 501 and/or 502; ASP 400, 483, 486, 581; BCP 581; EST 409. Thesis topic and additional course work will be selected by the student after consultation with, and approval of, the major professor.

*Aquatic pathology:* thesis and 24 credits of course work to include two semesters of graduate seminar, ASP 501 and/or 502; ASP 400, 486, 534, 536, 555, 556. Thesis topic and additional course work will be selected by the student after consultation with, and approval of, the major professor.

## DOCTOR OF PHILOSOPHY (Biological Sciences)

### Specializations

*Animal virology:* characterization of avian and marine viral infections; recovery of viruses from estuaries, streams, and ponds.

*Aquatic pathology:* pathology of aquatic animals; effects of environmental pollution on marine organisms.

### Admission Requirements

Same as for master's degree, plus Ph.D. qualifying exam.

### Program Requirements

*Animal virology:* enrollment in two semesters of graduate seminar; ASP 534, 536, 538; BCP 581, 582; MIC 432, 533, 552, 641. Suggested courses include BCP 622, 624. Dissertation topic and additional course work will be selected by the student after

consultation with, and approval of, the major professor. Comprehensive examination and dissertation.

*Aquatic pathology:* enrollment in two semesters of graduate seminar, ASP 400, 401, 486, 534, 536, 555, 556; BCP 581, 582; EST 532. Suggested courses include ASP 538, 584, 586; BCP 622, 624; MIC 533. Dissertation topic and additional course work will be selected by the student after consultation with, and approval of, the major professor. Comprehensive examination and dissertation.

### ASP Courses

#### Aquacultural Science and Pathology

400 Diseases of Cultured Fishes (I, 2)

401 Abnormal Biology (I, 3)

476 The Genetics of Fish (I, 3)

481 Shellfish Aquaculture Laboratory (I, 2)

483 Salmonid Aquaculture (I, 3)

486 Applied Physiology of Fish (II, 3)

501, 502 Seminar (I and II, 1 each) Preparation and presentation of scientific papers on selected subjects in animal pathology and virology. Wolke

532 Experimental Design

See Experimental Statistics 532.

534 (or MIC 534) Animal Virology (I, 3)

Basic properties, classification, and evolution of animal viruses. Individual agents are studied in detail. (Lec. 3) Pre: MIC 432, 533, or permission of chairperson. Chang

536 (or MIC 536) Virology Laboratory

(I, 2) Methods employed in diagnosis and for the investigation of the biological, physical, and chemical properties of animal viruses. (Lab. 6) Pre: credit or concurrent enrollment in 534. Chang

538 (or MIC 538) Epidemiology of Viral and Rickettsial Diseases (II, 2) Principles of epidemiology. Interrelationships of host, environment, and agent in viral and rickettsial diseases. (Lec. 2) Pre: credit or concurrent enrollment in 534. In alternate years. Next offered 1993–94. Chang

555, 556 Pathology Rotation (I and II, 3 each) Applied anatomical and clinical pathology of aquatic animals including necropsy duty and/or clinical hematology, chemistry, microbiology, parasitology. Attendance at weekly histopathology seminar and research/case report required. (Lab. 6) Pre: one course in histology or ZOO 323, MIC 432, or permission of instructor. In alternate years. Next offered 1993–94. Wolke

581 Current Topics in Molluscan Aquaculture (I, 3) Review and critical analysis of recent literature within the field of molluscan biology with emphasis on application to mariculture techniques. Student presentation of selected topics and field trips to state-of-the-art mariculture facilities. (Lec. 3) Pre: graduate standing or senior standing with permission of instructor. Rice

**584 Advanced Aquaculture Systems (II, 3)** Development of design criteria, operational analysis, and management of selected species in water reuse systems. (*Lec. 2, Lab. 2*) In alternate years. Next offered 1993–94. Staff

**586 Fish Nutrition (I, 3)** Digestion and metabolism of carbohydrate, protein, and lipids by fish. Role of vitamins and minerals in metabolism and associative nutritional diseases resulting from deficiencies. Inadvertent toxic factors in fish feeds. (*Lec. 3*) Pre: 412 and CHM 228 or equivalent. In alternate years. Next offered 1993–94. Staff

**591, 592 Special Projects (I and II, 1–3 each)** Research projects in animal pathology, virology, and aquaculture. Pre: graduate standing or permission of chairperson. Staff

**599 Master's Thesis Research (I and II)** Number of credits is determined each semester in consultation with the major professor or program committee. S/U credit.

**699 Doctoral Dissertation Research (I and II)** Number of credits is determined each semester in consultation with the major professor or program committee. S/U credit.

## AVS Courses

### Animal and Veterinary Science

**412 Animal Nutrition (I, 3)**  
**420 Animal Breeding and Genetics (II, 3)**  
**462 Laboratory Animal Techniques (II, 3)**  
**463 Animal Veterinary Technology (II, 3)**  
**472 Physiology of Reproduction (II, 3)**  
**491, 492 Special Projects (I and II, 1–3 each)**

**591, 592 Research Problems (I and II, 3 each)** Research problems to meet individual needs of graduate and honors students in the field of animal breeding, nutrition, or physiology and food science. (*Lab. 6, TBA*) Pre: permission of chairperson. Staff

## FST Courses

### Fisheries Science and Technology

**415 Fishery Science (I, 3)**  
**421 Theory of Fishing Gear Design (I, 3)**  
**433 Research Diving Methods (I, 3)**

**510 Applied Problems in Marine Fisheries Ecology (I, 3)** A study of the interaction between the marine environment and the fisheries, the effects of the environment on individual fish, the life histories of fish, fish behavior, and fish migration. (*Lec. 2, Lab. 3*) Pre: permission of instructor. DeAlteris

**516 Early Life History of Aquatic Resource Animals (II, 3)** Biology and ecology of juvenile and planktonic commercially important species; dynamics of reproduction, fecundity, growth, distribution, and behavior as modulated by the physical environment; identification, enumeration, and sampling. (*Lec. 2, Lab. 3*) Pre: 415 and EST 408. Recksiek

**521 Evaluation of Fish Capture System (II, 3)** Evaluation of fish capture system behavior and performance using empirical, theoretical, model scaling, and statistical analysis techniques. Field and laboratory measurement procedures. (*Lec. 2, Lab. 3*) Pre: 421 or permission of instructor. DeAlteris

**591, 592 Special Problems (I and II, 1–3 each)** Advanced work under the supervision of a staff member arranged to suit individual needs of students in various fields of fisheries and marine technology. (*Lec. and/or Lab. according to nature of problem*) Pre: graduate standing or permission of chairperson. Staff

## Food Science and Nutrition

M.S., Ph.D. (Biological Sciences)  
 401-792-2466

### Graduate Faculty

*Chairperson:* Professor Richard W. Traxler, Ph.D., 1958, University of Texas  
 Professor Marjorie J. Caldwell, Ph.D., 1972, Cornell University  
 Professor Spiros M. Constantinides, Ph.D., 1966, Michigan State University  
 Professor Chong Min Lee, Ph.D., 1974, University of Rhode Island  
 Professor Arthur G. Rand, Jr., Ph.D., 1964, University of Wisconsin  
 Professor Kenneth L. Simpson, Ph.D., 1963, University of California  
 Associate Professor Ruth E. Eshleman, Ed.D., 1975, Teachers College, Columbia University  
 Associate Professor Leonard Gerber, Ph.D., 1980, University of Illinois  
 Associate Professor Geoffrey W. Greene, Ph.D., 1984, Pennsylvania State University  
 Assistant Professor Catherine English, Ph.D., 1993, University of Connecticut  
 Assistant Professor Anthony S. Fischel, Ph.D., 1986, Rutgers—The State University  
 Adjunct Professor Edward S. Josephson, Ph.D., 1940, Massachusetts Institute of Technology  
 Adjunct Associate Professor Linda Sebelia, M.S., 1974, Ohio State University

### Specializations

*Food science:* seafood utilization by preservation and product development, seafood quality assessment, fabricated surimi-based products; food quality control and safety; food engineering; environmental microbiology; biotechnology applications of bioprocessing and fermentation; biochemical and physical properties of foods; and international food technology.

*Nutritional science:* nutritional status and food habits of population groups; vitamin A and provitamin A analysis and metabolism; nutrition policy; nutrition for athletes and

in weight control—diet and exercise; aquacultural nutrition; nutrition and computers in foodservice management; and international nutrition.

### Dietetics Experience Certificate Program

*Admission requirements:* cumulative undergraduate quality point average of 3.00 or better; an earned bachelor's degree with completion of the American Dietetic Association (ADA) Plan IV/V program requirements; and the ADA Verification Statement or ADA Declaration of Intent Form from their Plan IV/V program director. Six credits of acceptable course work in the discipline beyond the bachelor's degree are required for applicants whose bachelor's degrees were completed prior to 1986; at least 12 credits are required if the bachelor's degree was completed prior to 1981. Completion of the Graduate School application package and the PreProfessional Practice Program (AP4) application are required. Criteria used for admission include a balance of: a) academic achievement; b) relevant work experience; c) statement of purpose; and d) professional recommendations. Admission is for the fall term only. Fall 1993 enrollment is expected to be limited to eight students. Program information and application deadlines can be obtained by contacting the department.

*Program requirements:* The Dietetics Experience Certificate Program is an ADA-approved preprofessional practice program (AP4) and is administered under the department's nondegree status. The program consists of 46 weeks of course work and planned experiences in health care facilities in Rhode Island.

### Master of Science

*Admission requirements:* GRE and bachelor's degree with adequate preparation in biochemistry, statistics, and in the area of proposed study. Students from other academic backgrounds are encouraged to apply, but some basic courses may have to be taken for no program credit. The completed application package must be received by April 15 for fall admission and November 15 for spring admission.

*Program requirements:* thesis; two credits of FSN 511; a minimum of three credits in biochemistry, chemistry, microbiology, or physiology; in food science, FSN 422, 431, 432, and 502, or, in nutritional science, a minimum of six credits (FSN 441 plus one 500-level course). If the student has taken any of the courses as an undergraduate, alternate courses should be taken in the same area. All resident students are expected to be continuously registered in FSN 511 or 512, but no more than two credits of FSN 511 can be used for program credit.

## Doctor of Philosophy

**Admission requirements:** GRE and master's degree in a physical or biological science. Students from other academic backgrounds are encouraged to apply, but some basic courses may have to be taken for no program credit. The completed application package must be received by April 15 for fall admission and November 15 for spring admission.

**Program requirements:** same as master's degree plus statistics (EST 532 or equivalent), a total of three credits in FSN 511, and a research problem (FSN 691, 692) under the supervision of an advisor other than the major professor. Comprehensive examination and dissertation. Each candidate must also gain teaching experience in at least one college-level course. All resident students are expected to be continuously registered in FSN 511 or 512, but no more than three credits of FSN 511 can be used for program credit. Qualifying examination is required for students admitted without a master's degree or without a strong background in the proposed area of study.

## FSN Courses

### Food Science and Nutrition

- 421 Food Analysis (I, 4)
- 422 (or MIC 422) Biotechnology of Industrial Microorganisms (II, 3)
- 431 Biochemistry of Food (I, 3)
- 432 Food Processing (II, 3)
- 433 Food Quality (II, 3)
- 434 Marine Food Processing (II, 4)
- 438 Food Chemistry Laboratory (I, 3)
- 441 Advanced Human Nutrition (I, 3)
- 444 Nutrition and Disease (II, 3)
- 447 (or CHE 447) Food Engineering I (I, 4)
- 458 Nutrition Education (I or II, 3)
- 461 Food Safety (II, 3)
- 491, 492 Special Projects (I and II, 1–3 each)

**502 Physical Chemistry and Properties of Food (I, 3)** Principles of physical chemistry and properties of food material. Analysis of changes in physical properties and interaction of food components during physical processing. Application of underlying principles in food formulation and processing. (Lec. 2, Lab. 2) *Pre:* 431 or permission of chairperson. Lee

**503 Food Science and Nutrition Research Methods (I, 4)** Theory and practice in techniques and methods as applied to research in food science and nutritional science. (Lec. 1, Lab. 6) *Pre:* permission of chairperson. Simpson

**504 Research Methods in Dietetics (SS, 3)** Research methods and techniques applied to the field of dietetics. Research project designed by each student. (Lec. 3) *Pre:* 951, 952, and 953, or permission of instructor. Greene

**511 Food Science and Nutrition Seminar I (I and II, 1)** Reports and discussions of current topics in food science and nutrition, as well as oral reports of theses and dissertation research topics in progress. (Lec. 1) *Pre:* graduate standing or permission of chairperson. Staff

**512 Food Science and Nutrition Seminar II (I and II, 1)** Critical review of oral presentations presented in 511. Provides student with experience in communicative skills necessary to evaluate and critique scientific presentations. Attendance is required of all graduate students in residence when not enrolled in 511. (Lec. 1) *Pre:* graduate standing. S/U credit. Staff

**523 Water Pollution Microbiology**  
See Microbiology 523.

**525 Water Pollution Microbiology Laboratory**  
See Microbiology 525.

**526 (or MCH 526) Lipid Chemistry (I, 3)** Advanced course in the chemistry of biologically important lipids such as the fatty acids, neutral glycerides, phospholipids, steroids, and the chemistry and biochemistry of the carotenoids. (Lec. 3) *Pre:* BCP 581. In alternate years. Next offered 1993–94. Gerber and Simpson

**532 Seafood Quality (II, 3)** Biochemical and microbiological deterioration of seafoods, methods utilizing these reactions for quality assessment, and processes to inhibit these reactions for preservation of fresh seafoods. (Lec. 1, Lab. 4) *Pre:* 421, 432 or permission of instructor. In alternate years. Next offered 1994–95. Lee

**542 Minerals and Vitamins (II, 3)** Recent research in minerals and vitamins as related to human nutrition. Discusses the interrelationship between minerals, vitamins, and other nutrients as they relate to nutrition status. (Lec. 3) *Pre:* 441 or permission of chairperson. In alternate years. Next offered 1993–94. Gerber

**545 Protein Nutrition (II, 3)** Advanced course in protein nutrition emphasizing recent findings and research methodology; focus on comparative aspects of human and animal nutrition. (Lec. 3) *Pre:* credit in 441 or AVS 412 or permission of instructor. In alternate years. Next offered 1994–95. Caldwell and Nippo

**548 Separations for Biotechnology**  
See Chemical Engineering 548.

**549 Food and Biochemical Engineering III**  
See Chemical Engineering 549.

**550 Issues in International Nutrition (I, 3)** Nutrition related problems of developing countries. Causes and consequences of undernutrition and evaluation of methods for treatment and prevention. Current issues in international nutrition. (Lec. 3) *Pre:* graduate standing, 207 or permission of instructor. In alternate years. Next offered 1993–94. Caldwell

**591, 592 Special Research Problem (I and II, 1–4 each)** Advanced work under supervision of a staff member. Arranged to suit individual requirements of students. *Pre:* permission of chairperson. Staff

**599 Master's Thesis Research (I and II)** Number of credits is determined each semester in consultation with the major professor or program committee. S/U credit.

**691, 692 Research in Food Science and Nutrition (I and II, 1–3 each)** Assigned research on an advanced level. Students are required to outline the problem, conduct the necessary literature survey and experimental work, and to present their observations and conclusions in a report. Staff

**699 Doctoral Dissertation Research (I and II)** Number of credits is determined each semester in consultation with the major professor or program committee. S/U credit.

**951 Dietetics Seminar: Clinical Nutrition (I and II, 1–2)** Discussion of current topics in clinical nutrition related to supervised experience. Limited to students enrolled in the Rhode Island AP4 Program. (Lec. 1–2) Greene

**952 Dietetics Seminar: Community Nutrition (I and II, 1–2)** Discussion of current topics in community nutrition related to supervised experience. Limited to students enrolled in the Rhode Island AP4 Program. (Lec. 1–2) Greene

**953 Dietetics Seminar: Foodservice Management (I and II, 1–2)** Discussion of current topics in foodservice management related to supervised experience. Limited to students enrolled in the Rhode Island AP4 Program. (Lec. 1–2) Greene

## French

M.A.  
401-792-5911

### Graduate Faculty

**Chairperson:** Professor John Grandin, Ph.D., 1970, University of Michigan  
**Director of Graduate Studies:** Associate Professor Joseph G. Morello, Ph.D., 1968, University of Missouri  
Professor Armand B. Chartier, Ph.D., 1970, University of Massachusetts, Amherst  
Professor JoAnn Hammadou, Ph.D., 1988, Ohio State University  
Professor Kenneth H. Rogers, Ph.D., 1970, Columbia University  
Professor H. Dorothy Rothschild, Ph.D., 1959, Columbia University  
Associate Professor Ira A. Kuhn, Ph.D., 1970, University of Kansas  
Associate Professor Constantin Toloudis, Ph.D., 1969, Rice University  
Professor Emeritus Otto Dornberg, Ph.D., 1966, Ohio State University  
Professor Emeritus Harold A. Waters, Ph.D., 1956, University of Washington

### Specializations

French studies that include French literature, French-Canadian literature, Black-French studies, linguistics.

### Master of Arts

*Admission requirements:* 24 credits or equivalent of French, of which a minimum of nine must be in literature.

*Program requirements:* thesis—eight 500-level courses and a comprehensive examination; nonthesis—ten 500-level courses, including one course with a major paper requiring significant independent research, and comprehensive examination. A maximum of six credits from 400-level courses may be substituted for 500-level courses in the thesis or the nonthesis program.

### FRN Courses French

- 402 French Phonetics (II, 3)
- 411 Medieval Literature (I, 3)
- 422 Sixteenth-Century Literature (I or II, 3)
- 433 Seventeenth-Century Literature (II, 3)
- 443 Eighteenth-Century Literature (I, 3)
- 453 Nineteenth-Century Literature Until 1848 (I, 3)
- 454 Nineteenth-Century Literature Since 1848 (I, 3)
- 461 Twentieth-Century Theatre (II, 3)
- 465 Twentieth-Century Prose (I, 3)
- 473 French-Canadian Literature (II, 3)
- 474 Black Literature in French (II, 3)
- 480 Business French (I or II, 3)
- 497, 498 Directed Study (I and II, 3 each)

501 Advanced Composition (II, 3) Stylistics to prepare undergraduate and graduate French majors to write expository French prose. (Lec. 3) *Pre: graduate status or permission of instructor. In alternate years.* Staff

503 History of the French Language (II, 3) Linguistic development of French from the earliest documents to the present. Gallo-Romance dialects; the spread of French in and beyond Europe. (Lec. 3) *Pre: graduate status or permission of instructor.* Rogers

*Note: Courses 513–594 include lectures, discussions, readings, individual research, and a research paper.*

513 Seminar in Medieval Literature (I, 3) *Pre: graduate standing or permission of instructor.* Staff

523 Seminar in Sixteenth-Century Literature (I, 3) *Pre: graduate standing or permission of instructor.* Rothschild

533 Seminar in Seventeenth-Century Literature (I, 3) *Pre: graduate standing or permission of instructor.* Morello

544 Seminar in Eighteenth-Century Literature (II, 3) *Pre: graduate standing or permission of instructor.* Rothschild

554, 555 Seminar in Nineteenth-Century Literature (I and II, 3 each) *Pre: graduate standing or permission of instructor.* Touloudis and Chartier

564 Seminar in Modern Poetry (I, 3) *Pre: graduate standing or permission of instructor.* Staff

565 Seminar in Twentieth-Century Theatre (II, 3) *Pre: graduate standing or permission of instructor.* Kuhn

566 Seminar in Twentieth-Century Prose (I, 3) *Pre: graduate standing or permission of instructor.* Toloudis

594 Special Topics (I and II, 3) Group and/or individual investigation of special problems in French language, literature, and civilization. *Pre: acceptance of project by a staff member and permission of the chairperson.* Staff

599 Master's Thesis Research (I and II) Number of credits is determined each semester in consultation with the major professor or program committee. *S/U credit.*

## Geology

M.S.  
401-792-2265

### Graduate Faculty

*Chairperson:* Professor O. Don Hermes, Ph.D., 1967, University of North Carolina

*Director of Graduate Studies:* Assistant Professor Anne I. Veeger, Ph.D., 1991, University of Arizona

Professor Jon C. Boothroyd, Ph.D., 1974, University of South Carolina  
Professor and State Geologist J. Allan Cain, Ph.D., 1962, Northwestern University

Associate Professor David E. Fastovsky, Ph.D., 1986, University of Wisconsin  
Associate Professor Reinhard K. Frohlich, Ph.D., 1966, University of Clausthal-Zellerfeld

Associate Professor Daniel P. Murray, Ph.D., 1976, Brown University

### Specializations

*Sedimentology:* emphasis on field projects—a) measurement of Recent barrier, lagoonal and estuarine processes, and investigation of lithofacies; b) Recent braided rivers and alluvial fans; c) depositional systems of ancient rocks.

*Stratigraphy—paleontology:* paleoenvironmental reconstructions, historical geology, paleontology, paleobiology.

*Coastal geomorphology:* analysis of coastal land forms using field techniques, remote-sensing aerial and satellite imagery. Emphasis on Rhode Island barriers, Cape Cod, and barrier islands of the Atlantic coast.

*Glacial geology:* sedimentary aspects of Pleistocene and Recent glacial paleoenvironments of New England and Alaska; environmental mapping.

*Hydrogeology:* field and laboratory studies of groundwater flow, low-temperature geochemistry, and the interaction between groundwater and the geologic framework.

*Applied geophysics:* near-surface geophysics such as geoelectrics, gravity, and refraction seismic for groundwater and related topics. Gravity and magnetics related to structural and plutonic geology in southern New England.

*Remote sensing:* applied remote sensing using optical and computer analysis of satellite imagery and aerial photography in geomorphology and coastal, structural, planetary, and environmental geology.

*Petrology—geochemistry:* field and laboratory petrologic studies in the New England Appalachians, in the Sierra Nevada of California, and elsewhere, including petrogenesis of volcanic, plutonic, and metamorphic rocks.

*Structure and tectonics:* deformation at regional and microscopic scales; relationship between deformation and metamorphism; emphasis on New England tectonics.

*Planetary geology:* origin and history of chasms, channels, and valleys of Mars.

*Resource and environmental studies:* relevant aspects of the above specializations.

Individual programs may include courses and/or research in conjunction with the Graduate School of Oceanography and other departments; interdisciplinary studies are encouraged.

### Master of Science

*Admission requirements:* GRE and bachelor's degree in science or engineering. By the end of the first year, students lacking an undergraduate major equivalent to the bachelor of science degree in geology will be required to demonstrate, through course work and/or qualifying examinations, comparable knowledge of geology and related fields.

*Program requirements:* thesis option—30 credits of course work; thesis and defense; an oral comprehensive examination; and a graduate seminar (for no program credit). Nonthesis option—36 credits of course work, not including a graduate seminar, with half or more credits at the 500 level or above and 18 or more credits in geology; GEL 592; advanced seminars in the relevant area(s) of specialization; an oral comprehensive examination; and a written comprehensive examination.

### GEL Courses Geology

- 401 Ore Deposits (II, 3)
- 421 Geochemistry (I, 3)
- 450 Introduction to Sedimentation and Stratigraphy (I, 4)

**465 Introduction to Geophysics (I, 3)**  
**468 Hydrogeochemistry (II, 3)**  
**483 Hydrogeology (I, 3)**  
**485 (or CVE 485) Engineering Geophysics (II, 3)**

**487 Quantitative Geology (II, 3)**  
**488 Geological Evolution of North America (II, 3)**

**515 Glacial Geology (I, 3)** Investigation of late Cenozoic glaciation including areas with presently existing glaciers. Primary stress on sedimentology and geomorphology of glacial deposits. Field trips in New England area. (*Lec. 2, Lab. 3*) *Pre: 450 or permission of instructor. Boothroyd*

**530 Igneous Petrology (II, 3)** Tectonic and chemical basis for igneous phenomena stressing the association concept of igneous activity. Evaluation of the criteria used in petrogenetic interpretations. (*Lec. 2, Lab. 3*) *Pre: 321 or permission of instructor. In alternate years. Hermes*

**531 Metamorphic Petrology (I, 3)** Facies concept and other methods of interpreting metamorphic mineral assemblages. Chemical and fabric changes during metamorphism, including principles of structural petrology. (*Lec. 2, Lab. 3*) *Pre: 321 or permission of instructor. In alternate years. Murray*

**550 Sedimentary Processes (II, 3)** Physical and chemical processes of sedimentation with emphasis on fluvial, beach, and estuarine environments. Stress on field applications of theory, with independent project and reading. (*Lec. 2, Lab. 3*) *Pre: 450 or permission of instructor. Offered in spring of odd-numbered years. Boothroyd*

**554 Sedimentary Petrology (I, 3)** The detailed interpretation of siliciclastic and carbonate fabrics and textures in thin section and hand sample. Emphasizes aspects of diagenesis, including cementation, replacement, recrystallization, pedogenesis, and porosity evolution. Skeletal elements and paleoenvironmental context presented. (*Lec. 2, Lab. 2*) *Pre: 240 and 450 or permission of instructor. In alternate years. Fastovsky*

**565 Advanced Interpretation in Applied Geophysics (II, 3)** Interpretation of geophysical data using theoretical models. Reflection, refraction, and surface propagation of seismic energy. Computer analysis of gravity and magnetic potential data. DC geoelectrical potential over horizontally stratified medium. (*Lec. 2, Lab. 2*) *Pre: MTH 243, PHY 214, or equivalent course in physics with permission of instructor. Offered in spring of odd-numbered years. Frohlich*

**568 Isotopes in Hydrogeology (II, 3)** Use of environmental isotopes in groundwater studies; dating groundwater, delineating flow paths and identifying recharge areas, geochemical evolution of groundwater and assessment of contamination. (*Lec. 3*) *Pre: 483 and 468 or permission of instructor. Offered in even-numbered years. Veeger*

**570 Structural Analysis (I, 3)** Mapping and geometric analysis of structures in variably deformed terrains. (*Lec. 1, Lab. 4*) *Pre: 321, 370, 480, or permission of instructor. Offered in fall of even-numbered years. Murray*

**577 Coastal Geologic Hazards (II, 3)** Geologic hazards in the coastal zone and their impact on society. Includes waves, storm-surge, mass-wasting, and sea level rise. Geologic effectiveness of engineering structures and management techniques. Emphasis on field study. (*Lec. 2, Lab. 3*) *Pre: 450 or permission of instructor. Offered in spring of even-numbered years. Boothroyd*

**580 New England Geology (I, 3)** Review of the bedrock geology of New England, and its applications for the Appalachian/Caledonides mountain chain and theories of orogenesis. Mandatory field trips. (*Lec. 3*) *Pre: 321, 370, or permission of instructor. Offered in fall of odd-numbered years. Murray*

**581 (or OCG 581) Topics in Tectonic Geology (I, 3)** Review of selected topics in continental and oceanic tectonics. (*Sem. 3*) *Pre: permission of instructor. Offered in fall of even-numbered years. Murray and Fox*

**583 Advanced Hydrogeology (II, 3)** Advanced analysis of groundwater systems and the relationship between groundwater and geology. Principles and equations for groundwater flow in complex aquifers, groundwater modeling. Groundwater modeling project. (*Lec. 2, Lab. 3*) *Pre: 483 or 585 and MTH 244 or permission of instructor. Offered in odd-numbered years. Veeger*

**590 Special Problems (I and II, 1-3)** Advanced work under the supervision of a staff member arranged to suit the individual requirements of the student. (*Lec. and/or Lab. according to the nature of the problem*) *Pre: permission of instructor. Staff*

**591 Special Problems (I and II, 1-3)** Advanced work under the supervision of a staff member arranged to suit the individual requirements of the student. (*Lec. and/or Lab. according to the nature of the problem*) *Pre: permission of instructor. S/U credit. Staff*

**592 Nonthesis Master's Research (I and II, 3)** Independent research for fulfillment of research requirement of nonthesis master's degree. Detailed report required. *Pre: permission of chairperson. S/U credit. Staff*

**599 Master's Thesis Research (I and II)** Number of credits is determined each semester in consultation with the major professor or program committee. *S/U credit.*

**930 Workshop in Geology Topics for Teachers (I and II, 0-3 each)** Especially designed for teachers of physical sciences. Basic topics of geology from an advanced or pedagogical perspective. *Pre: teacher certification. Staff*

*Note: For other related courses, see OCG 540, 541, 542, 625, 628, 629, 641, 643, 644, 645, 646, 647, 648, 649, 651, 652, 653, 654, 678, 681 and CVE 581, 582, 585, 587, 588, 677, 681, 682, 687.*

## History

M.A.  
 401-792-2528

### Graduate Faculty

*Chairperson:* Professor Josiah M. Briggs, Ph.D., 1962, Columbia University

*Director of Graduate Studies:* Professor James F. Findlay, Jr., Ph.D., 1961, Northwestern University

Professor Joel A. Cohen, Ph.D., 1967, University of Connecticut

Professor Frank Costigliola, Ph.D., 1973, Cornell University

Professor Robert M. Gutchen, Ph.D., 1966, Columbia University

Professor Chong Sun Kim, Ph.D., 1965, University of Washington

Professor Maurice N. Klein, Ph.D., 1965, Emory University

Professor Sharon H. Strom, Ph.D., 1969, Cornell University

Professor Gary Thurston, Ph.D., 1973, Columbia University

Professor Robert G. Weisbord, Ph.D., 1966, New York University Graduate School

Associate Professor Michael W. Honhart, Ph.D., 1972, Duke University

Assistant Professor Charles E. Daniel, Jr., Ph.D., 1968, Ohio State University

Assistant Professor Rosemarie Pegueros, Ph.D., 1993, University of California, Los Angeles

Assistant Professor Seth Schwartz, Ph.D., 1985, Columbia University

Adjunct Associate Professor Albert T. Klyberg, M.A., 1963, University of Michigan

Assistant Professor Emeritus Gino Silvestri, Ph.D., 1969, Syracuse University

### Specializations

History of the United States; history of Europe; Third World history. These three areas of specialization include courses in: American, diplomatic, East Asian, African, black, Latin American and women's history; imperialism; history of science; modern English history; modern European history; state and local history.

The master's program in history is largely individually structured with directed studies, seminars, colloquia, and tutorials. With a tutorial, the graduate student will audit the lectures of a 300-level course and, in addition, will meet in tutorial sessions with the lecturer to pursue the topic at greater depth. For tutorials, the student may register for HIS 502 or 503 (if the 300-level course deals with European history), HIS 536 or 537 (if the 300-level course deals with American history), or HIS 588 or 589 (if the 300-level course deals with Third World history). These 500-level tutorial courses may be repeated for different 300-level courses in each area, but no more than five of these tutorials will be permitted in

the graduate program. Tutorial arrangements must be made with the instructor at the beginning of the semester. For a listing of the 300-level courses, see the *Undergraduate Bulletin*.

#### Master of Arts

**Admission requirements:** GRE (advanced test desirable) and bachelor's degree with at least 24 credits in history. Majors in related fields may be admitted with permission of the chairperson.

**Program requirements:** thesis option—30 credits, to include four courses at 500 level, at least two of which must be colloquia; nonthesis option—30 credits, to include five courses at the 500 level, at least two of which must be colloquia and one a seminar. Both options require an oral examination. The nonthesis option also requires a four-hour written examination. Two courses in a related field are allowed.

#### Cooperative Program (M.A. and M.L.I.S.)

By proper selection of course work, a student may simultaneously earn the degrees of Master of Arts in history and Master of Library and Information Studies.

**Admission requirements:** GRE (subject test desirable) and other requirements listed for history and library science. Applicant must apply and be accepted in both programs. The application for each program must indicate history/library and information studies as the field of specialization.

**Program requirements:** students must submit individual programs of study for each degree that satisfy specific core requirements for these programs. Since a maximum of six credits may be jointly used to satisfy degree requirements, a minimum of 66 credits total is required to satisfy the requirements for both degrees.

#### HIS Courses History

**401 Advanced Topics in European History** (I or II, 3)

**441 Advanced Topics in American History** (I or II, 3)

**481 Advanced Topics in Third World History** (I or II, 3)

**500 Colloquium in Selected Topics in History** (I or II, 3) Intensive study of major interpretive works in various thematic, crossnational topics. (Sem. 3) *Pre: graduate or senior standing and permission of instructor.* Staff

**502, 503 Special Readings in European History** (I and II, 3 each) Intensive tutorial work, research, and readings in European history. *Pre: graduate standing, permission of instructor, and concurrent audit of parallel 300-level course. May be repeated.* Staff

**505 Seminar in Selected Topics in History** (I or II, 3) Intensive research on selected thematic, crossnational topics. (Sem. 3) *Pre: graduate or senior standing and permission of instructor.* Staff

**536, 537 Special Readings in American History** (I and II, 3 each) Intensive tutorial work, research, and readings in American history. *Pre: graduate standing, permission of instructor, and concurrent audit of parallel 300-level course. May be repeated.* Staff

**544 Colloquium in Worker History**  
See Labor and Industrial Relations 544.

**588, 589 Special Readings in Third World History** (I and II, 3 each) Intensive tutorial work, research, and readings in Third World history. *Pre: graduate standing and permission of instructor. Concurrent audit of parallel 300-level course required. May be repeated.* Staff

**591 Directed Study or Research** (I and II, 3) Directed readings, research, or study designed to meet the particular needs of individuals or small groups of graduate students. Staff

**599 Master's Thesis Research** (I and II)  
Number of credits is determined each semester in consultation with the major professor or program committee. *S/U credit.*

### Human Development and Family Studies

M.S.  
401-792-2150

#### Graduate Faculty

**Chairperson:** Associate Professor David A. Caruso, Ph.D., 1985, Cornell University  
**Director of Graduate Studies:** Associate Professor Jerome A. Schaffran, Ph.D., 1971, University of Iowa

**Human Development and Family Studies**  
**Coordinator:** Associate Professor Diane Horm-Wingerd, Ph.D., 1985, Virginia Polytechnic Institute

Professor Stewart Cohen, Ph.D., 1967, Purdue University  
Professor Gwenneth Rae, Ed.D., 1972, University of California  
Associate Professor Joan Gray Anderson, Ph.D., 1984, University of California  
Associate Professor David A. Caruso, Ph.D., 1985, Cornell University  
Associate Professor Phillip G. Clark, 1979, Sc.D., Harvard University  
Assistant Professor Karen A. Schroeder, Ph.D., 1977, University of Connecticut  
Assistant Professor Jingjian Xiao, Ph.D., 1991, Oregon State University  
Associate Professor Emerita Helen F. Greene, Ph.D., 1954, Florida State University

#### Marriage and Family Therapy

**Coordinator:** Professor Peter E. Maynard, Ph.D., 1969, State University of New York, Buffalo  
Professor Gwenneth Rae, Ed.D., 1972, University of California  
Associate Professor Jerome A. Schaffran, Ph.D., 1971, University of Iowa  
Assistant Professor Jerome Adams, Ph.D., 1989, Purdue University  
Assistant Professor Karen A. Schroeder, Ph.D., 1977, University of Connecticut

#### College Student Personnel

**Coordinator:** Associate Professor Jerome A. Schaffran, Ph.D., 1971, University of Iowa  
Professor Peter E. Maynard, Ph.D., 1969, State University of New York, Buffalo  
Associate Professor Jayne Richmond, Ph.D., 1982, University of Florida  
Assistant Professor Gerry Rolley, Ed.D., 1992, University of Rochester

#### Specializations

Human development and family studies; marriage and family therapy; counseling; college student personnel.

#### Human Development and Family Studies

**Admission requirements:** GRE or MAT, PSY 300 or EST 308 or equivalent, and 18 undergraduate credits distributed among at least three of the following areas: human development and family studies, psychology, sociology, biology, and education. Subspecializations are available in human development, early childhood education, family studies, and gerontology.

**Program requirements:** nine credits of core courses—HDF 500, 530, and 570; six credits of thesis or action research; nine credits of free electives (one course must be taken outside the department); and a comprehensive examination. An additional 12 credits must be taken from one of the following subspecialization areas: early childhood education—HDF 400, 406, 434, 455, 501, 502, and 503; child development—HDF 400, 406, 434, 502, 503, and 504; adult development/gerontology—HDF 420, 421, 431, 433, 440, 505, 520, 527, 535, and 559; family studies—HDF 430, 431, 433, 434, 505, 535, and 559. A total of 36 credits are required.

**State Provisional Certification:** persons wishing to meet state provisional certification requirements (Nursery to Grade 2) must apply for admission to teacher certification (nondegree status). Official transcripts of all previous course work plus two letters of recommendation are required. As a prerequisite to enrolling in courses that meet certification requirements, accepted applicants must complete or have completed the equivalent of an undergraduate degree in human development and family studies.

## Marriage and Family Therapy

*Admission requirements:* GRE or MAT; at least 15 credits of relevant preparation courses, including family relations, developmental theory, personality theory, abnormal psychology, and introduction to counseling or an equivalent course; two letters of recommendation should be from supervisors in a related field attesting to observed experience, emotional stability, and maturity. After initial screening, qualified applicants will be required to come to campus for a personal interview. The goal of the personal interview is to determine whether the applicant possesses the full range of academic qualifications, experiential background, clinical competency, and readiness to undertake the rigors of an academically and emotionally demanding clinical preparation program. Several of the program's faculty members will conduct the interviews. Selection for admission to this program is highly competitive and enrollment is limited. Diversity among the students in the program is a major program goal. The program adheres to the standards established by the American Association for Marriage and Family Therapy (AAMFT). Completed application package must be received by March 1.

*Program requirements:* a minimum of 45 credits of approved graduate courses, including a 30-hour core and 15 credits of approved electives depending on previous training and background, and a comprehensive examination. This program involves intense clinical practice and a year-long internship at cooperating agencies or the department's Marriage and Family Therapy Clinic; therefore, full-time students are preferred.

## College Student Personnel

*Admission requirements:* GRE or MAT and interview; preference given to applicants with experience in student affairs.

*Program requirements:* 27 credits in core HDF courses (HDF 450, 551, 554, 560, 562, 567, 568, 570, 590), six credits in adult development and social science electives, plus one of the following—a) nonthesis option with internship (HDF 580, 581, 583, 584, and a comprehensive examination); b) nonthesis option with action research project (HDF 595, six credits, one additional elective, and a comprehensive examination); or c) thesis option (HDF 599, six credits, and one additional elective).

## HDF Courses

### Human Development and Family Studies

**400 (HCF) Child Development: Advanced Course** (*I and II, 3*)

**406 (HCF) Growth and Development During Infancy** (*I or II, 3*)

**420 (HCF) Human Development During Adulthood** (*I and II, 3*)

**421 (HCF) Death, Dying, and Bereavement** (*I or II, 3*)

**422 (HCF) Aging: Case Coordination** (*II, 3*)

**424 (HCF) Design and Delivery of Services for Mentally Retarded Adults** (*II, 3*)

**430 (HCF) Family Interaction** (*I and II, 3*)

**431 (HCF) Family and the Elderly** (*I or II, 3*)

**432 (HCF) Perspectives on Parenting** (*I or II, 3*)

**433 (HCF) Family Life Education** (*I or II, 3*)

**434 (HCF) Children and Families in Poverty** (*I or II, 3*)

**437 (HCF) (or SOC 437) Law and Families in the United States** (*I or II, 3*)

**440 (HCF) Environmental Context of Aging** (*I or II, 3*)

**450 (HCF) Introduction to Counseling** (*I and II, 3*)

**455 (HCF) Assessment in Early Childhood** (*II, 3*)

**456 (HCF) Assessment Practicum** (*II, 3*)

**497, 498 (HCF) Special Problems** (*I and II, 1–3 each*)

**500 (HCF) Human Development Seminar** (*I or II, 3*) Contemporary research issues emerging in the human development literature at five stages of development (infancy, childhood, adolescence, adulthood, and old age), with emphasis placed on continuity and transition across the life span. (*Sem.*) *Pre:* 400 or 420 or equivalent, or permission of instructor. Cohen

**501 (HCF) Seminar in Early Childhood Education** (*I or II, 3*) Seminar in trends and model programs in early childhood education. Special attention to substantive evaluation and program design issues for the professional early childhood educator. (*Lec. 3*) *Pre:* student teaching or equivalent classroom experience or permission of instructor. Staff

**502 (HCF) Cognitive Aspects of Early Childhood** (*I or II, 3*) Impact of theory and research in cognitive development and its relation to language, learning, and thinking. Special attention to Piaget's impact on current research and educational programs. (*Lec. 3*) *Pre:* 200, 201, or permission of instructor. Staff

**503 Social Development: Infancy Through Adolescence** (*I or II, 3*) Seminar providing in-depth examination and critique of theory and research in social development. Implications for diverse populations and applications for human service settings will be drawn. *Offered in alternate years.* (*Lec. 3*) Horm-Wingerd or Cohen

**504 (HCF) Contemporary Theories of Ego Development** (*I or II, 3*) Surveys of the recent theoretical constructs which synthesize the cognitive and psychosocial traditions into a developmental view of the ego. The relevance of the psychology of women to this synthesis is also considered. (*Sem. 3*) *Pre:* graduate standing and permission of instructor. In alternate years. Staff

**505 (HCF) Human Sexuality and Counseling** (*I or II, 3*) Historical, cultural, and developmental issues in human sexuality and counseling. Implications for self and client understanding through personal exploration and desensitization to sensitive topics. (*Lec. 3*) *Pre:* graduate standing or permission of instructor. Rae or Staff

**520 (HCF) Developmental Issues in Later Life** (*I or II, 3*) Theoretical and philosophical foundations for understanding the normal changes, pathological developments, clinical assessments, and intervention strategies associated with later life. (*Sem. 3*) *Pre:* graduate standing. Staff

**527 (HCF) Health Care Policy and the Elderly** (*I or II, 3*) Present and future problems in policy development to meet health care needs of the elderly. Consideration of historical aspects, demographic change, policy models. (*Sem. 3*) *Pre:* graduate standing. Staff

**529 (HCF) Practicum Seminar in Gerontology** (*I and II, 1*) A seminar focusing on adult development and aging. Designed for graduate students in gerontology to exchange results of original research or practical experiences through reports and discussions. *Pre:* graduate standing or permission of instructor. May be repeated for a maximum of 3 credits. Staff

**530 (HCF) Family Theory Seminar** (*I, 3*) Intensive study of theories in the family field, integrated with contemporary family issues, and family therapy. (*Lec. 3*) *Pre:* 430 or permission of instructor. Staff

**535 (HCF) Families Under Stress: Coping and Adaptation** (*I, 3*) Theoretical models of family interaction, development, and stress as applied to understanding of family behavior in managing stress or events. Concepts of stress, vulnerability, adaptability, coping, regenerative power, social supports, and related research. (*Lec. 3*) *Pre:* 430, 570, or equivalent graduate course work in family development or family sociology and permission of instructor. Staff

**550 (HCF) Vocational Information and Career Development** (*I or II, 3*) Classification and description of jobs and industries; study of occupational trends; needs of special groups entering the labor market; vocational development theories and counseling for long-range career planning. (*Lec. 3*) *Pre:* 450 and graduate standing. Staff

**551 (HCF) Counseling Theory and Techniques** (*I or II, 3*) Theoretical foundation and practice of counseling and therapy in various settings. (*Lec. 3*) *Pre:* 450 or permission of instructor. Staff

**553 (HCF) Counseling Practicum** (*I or II, 3*) Advanced counseling and therapy issues. Multiple sessions using tapes and critiques to assess growth and competence of the clinician. Limited enrollment. (*Lec. 1, Lab. 5*) *Pre:* 450, 551, advanced standing, and permission of instructor. Staff

**554 (HCF) Individual Appraisal in Human Services (I, 3)** Nature of the appraisal process and data essential to understanding the educational, vocational, and social needs of persons. Emphasis is on a team approach to counseling services and the utilization of case materials. (Lec. 3) Pre: 551 and 570. Staff

**555 (HCF) Gerontological Counseling (I or II, 3)** An overview of the developmental process of later life, particularly relevant to counselors and therapists. Clinical counseling implications and therapeutic strategies will be emphasized. (Lec. 3) Pre: 420, 450, or equivalent, and graduate standing. In alternate years. Staff

**559 (HCF) Gender Issues in Therapy (I or II, 3)** Systemic integration of the issues and therapeutic dilemmas growing out of society's changing views of women and men. Emphasis on research therapist self-awareness, and evaluation of current therapies. (Sem. 3) Pre: 450 or equivalent and graduate standing or permission of instructor. Rae

**560 (HCF) Group Procedures in Counseling (I or II, 3)** Principles and techniques of group counseling and therapy as applied to education, counseling, and student personnel work. A practical and theoretical approach with emphasis on facilitation techniques, leadership patterns, and counseling skills. Enrollment is limited. (Lec. 3) Pre: 551 and permission of instructor. Staff

**562 (HCF) Organization Development in Human Services (I or II, 3)** Theory and technology of organization development as applied in human service agencies; entry diagnosis, implementation, and evaluation strategies, skills practice in consulting and training; evaluation and research of change efforts. (Lec. 2, Lab. 4) Pre: 560. Staff

**563 (HCF) Marital and Family Therapy I (I, 3)** Major theoretical perspectives, including system theory as related to therapy. Communication and relationship skills, negotiation and behavioral contracting, treating specific relationship problems, therapy evaluation. (Sem. 3) Pre: 430 and permission of instructor. Staff

**564 (HCF) Marital and Family Therapy II (II, 3)** Major contemporary theories of family therapy and the development of family therapy as a unique intervention strategy; special consideration of issues and problems commonly confronted in conducting family therapy. (Lec. 3) Pre: 563. Maynard

**565 (HCF) Family Therapy Practicum (I, II, or SS, 3)** Supervised clinical experience in marriage and family therapy. Case materials will be presented by students, and taped segment of actual counseling sessions will be reviewed. (Lec. 1, Lab. 5) Pre: admission to MFT program or permission of instructor. May be repeated for a maximum of 18 credits. Staff

**566 (HCF) Theoretical and Clinical Problems (II, 3)** Examination of major ongoing and emerging theoretical issues in family therapy. The implications of these problems in clinical practice with families. (Lec. 3) Pre: 564 and graduate standing. Staff

**567 (HCF) Principles and Practices of Student Personnel Services in Higher Education (I, 3)** Survey of the historical, psychological, organizational, and educational factors which have evolved and combined to form student personnel work. (Lec. 3) Pre: graduate standing and permission of instructor. In alternate years. Staff

**568 (HCF) Organization and Administration of Student Personnel Services in Higher Education (II, 3)** Systematic analysis of current practices in the alignment and operation of student personnel services, with continuing review of their interrelationships with the total educational program. (Lec. 3) Pre: 567. In alternate years. Staff

**569 (HCF) Assessment in Family Therapy (I or II, 3)** Administration and interpretation of assessment instruments for treatment, planning and evaluation. Ethical, legal and theoretical issues related to family systems assessment are discussed. (Sem. 3) Pre: graduate standing or permission of instructor. Adams

**570 (HCF) Research in Human Development and Family Studies (I and II, 3)** Historical, philosophical, and procedural foundations of scientific inquiries into individuals and families. Explores the various ways to acquire information about human development and family relationships. (Lec. 3) Pre: graduate standing or permission of instructor. Staff

**580, 581 (HCF) Professional Seminar in Counseling (I and II, 3 each)** A two-semester sequence examining legal, ethical, and professional issues and standards related to counseling and therapy. Analysis of problems encountered in the internship experience. (Lec. 3) Pre: concurrent enrollment in 583, 584, advanced standing, and permission of instructor. Staff

**583, 584 (HCF) Master's Internship (I and II, 3 or 6 each)** Supervised field practice in mental health or family agencies, schools, or colleges to integrate counseling and therapy theories and skills. Pre: concurrent enrollment in 580 for 583, 581 for 584. Staff

**590 (HCF) Higher Education Law (I or II, 3)** An overview of federal and state legal systems' effect on university administration and service delivery. Reviews authorities and agencies, major court decisions, and the application of substantive and procedural law principles. (Lec. 3) Pre: graduate standing or permission of instructor. In alternate years. Staff

**595 (HCF) Master's Project: Action Research (I and II, 1-6)** Number of credits is determined each semester in consultation with the major professor. Minimum of 6 credits is required of students who have chosen the action-thesis option. S/U credit.

**597, 598 (HCF) Advanced Study (I and II, 1-3 each)** Survey of important research contributions significant to the understanding of human development and relationships. (Lec. 1-3) Staff

**599 (HCF) Master's Thesis Research (I and II)** Number of credits is determined each semester in consultation with the major professor or program committee. The minimum of 6 credits is required of students who have chosen the thesis option. S/U credit.

## HSS Courses

### Human Science and Services

**491, 492 Special Problems (I or II, 1-3 each)**

**530 Multidisciplinary Health Seminars for the Elderly (I or II, 3)** Field experience for students in various health disciplines. Development of assessment techniques, curricular materials, and team delivery of health seminars to the elderly at community sites. (Sem. 3) Pre: graduate standing or permission of instructor. Clark and Staff

**590 Seminar in Human Science (I or II, 3)** Investigation of human science as lived experience, reflective inquiry, and reflective practice. Development and presentation of individual projects embodying these characteristics of human science. (Lec. 3) Willis

## Industrial Engineering

See Manufacturing Engineering on page 67.

## Labor and Industrial Relations M.S.

401-792-2239

### Graduate Faculty

*Director, Labor Research Center:* Professor Charles T. Schmidt, Jr., Ph.D., 1968, Michigan State University (Professor of Industrial Relations)  
Professor Judith Anderson, Ph.D., 1970, Indiana University  
Professor Charles P. Armstrong, Ph.D., 1973, University of Arizona  
Professor Harold Barnett, Ph.D., 1973, Massachusetts Institute of Technology  
Professor Winifred E. Brownell, Ph.D., 1973, State University of New York, Buffalo  
Professor John P. Burkett, Ph.D., 1981, University of California, Berkeley  
Professor Norman Coates, Ph.D., 1967, Cornell University  
Professor Jerry Cohen, Ph.D., 1973, University of Illinois  
Professor William Croasdale, Ed.D., 1966, Teachers College, Columbia University  
Professor Albert J. Della Bitta, Ph.D., 1971, University of Massachusetts

Professor James F. Findlay, Jr., Ph.D., 1961, Northwestern University  
 Professor Timothy M. Hennessey, Ph.D., 1968, University of North Carolina  
 Professor Jeffrey E. Jarrett, Ph.D., 1967, New York University  
 Professor Andrew Laviano, J.D., 1982, New York University School of Law  
 Professor Bernice Lott, Ph.D., 1954, University of California, Los Angeles  
 Professor Craig E. Overton, Ph.D., 1971, University of Massachusetts  
 Professor John J. Poggie, Jr., Ph.D., 1968, University of Minnesota  
 Professor Lawrence Rothstein, Ph.D., 1976, University of Massachusetts  
 Professor Richard W. Scholl, Ph.D., 1980, University of California, Irvine  
 Professor Beatrice Schultz, Ph.D., 1969, University of Michigan  
 Professor James L. Starkey, Ph.D., 1971, Boston College  
 Professor Sharon H. Strom, Ph.D., 1969, Cornell University  
 Professor Robert Weisbord, Ph.D., 1966, New York University Graduate School  
 Associate Professor Laura Beauvais, Ph.D., 1987, University of Tennessee, Knoxville  
 Associate Professor Elizabeth Cooper, Ph.D., 1985, University of Akron  
 Associate Professor Diane Disney, Ph.D., 1989, Brandeis University  
 Associate Professor Sandra Ketrow, Ph.D., 1982, Indiana University  
 Associate Professor Leonard P. Lardaro, Ph.D., 1979, Indiana University  
 Associate Professor Blair M. Lord, Ph.D., 1975, University of California  
 Associate Professor Richard McIntyre, Ph.D., 1989, University of Massachusetts  
 Associate Professor Arthur C. Mead, Ph.D., 1978, Boston College  
 Associate Professor Yngve Ramstad, Ph.D., 1981, University of California, Berkeley  
 Assistant Professor Charles Latos, Ph.D., 1977, Brown University  
 Assistant Professor Carole Miller, Ph.D., 1988, Syracuse University  
 Assistant Professor D. Scott Molloy, Ph.D., 1991, Providence College  
 Assistant Professor Gail A. Shea, Ph.D., 1975, Brown University  
 Adjunct Professor J. Michael Keating, J.D., 1973, Georgetown University Law School  
 Adjunct Professor Suzanne Taylor, Ph.D., 1970, University of Connecticut  
 Professor Emeritus Carl Gersuny, Ph.D., 1968, Western Reserve University  
 Professor Emeritus Elton Rayack, Ph.D., 1957, University of Chicago

The program is designed for union, government, neutral, or human resource management, labor, and industrial relations professionals, or for those students who aspire to such positions. Students in other gradu-

ate programs may find it rewarding and professionally desirable to enroll in one or more of the labor relations and labor studies courses. All courses are offered in the very late afternoon or in the evening in Providence and Kingston so that they are convenient for those currently employed. Full-time or part-time programs are available.

#### Master of Science

*Admission requirements:* GRE or MAT or GMAT. Undergraduate majors in any field will be considered for admission. Those with social science, history, management, and labor studies majors are especially encouraged to apply, as are those with engineering, nursing, education, urban affairs, black studies, and women's studies backgrounds. Professional experience in labor and industrial relations will carry additional weight in admission decisions.

*Program requirements:* minimum of 36 credits including 27–28 credits in core courses and nine credits of specialization plus requirements of three credits each in statistics and computer science, which may be met by prior course work or examination, and a written master's examination. The required core courses (27–28 credits) are: LRS/HIS 544; LRS/PSC 521; LRS/SOC 432 or MGT 630; LRS/ECN 526 and 534; LRS 531, 541, 542, and 580.

The areas of specialization are listed here together with available courses. Substitutions may be made with permission of the director of the Labor Research Center and approval of the Graduate School.

*Labor relations:* three courses from LRS 520, 533, 545, 581, 590, 591; MGT 640; and LRS 543 or 579.

*Human resource administration:* three courses from MGT 640; PSC 503 or MGT 641; LRS 533, 545, 581, 590, 591 and LRS 543 or 579; PSY 434; EDC 529 or 583; and CPL 535 or 543.

*Labor and worker studies:* three courses from LRS 520, 545, 581, 590, 591; ENG 445; HIS 591; PSC 486; and PSY 480.

*Worker/labor or management education and training:* three courses from LRS/EDC 579; LRS 581; LRS 590, 591; EDC 505, 539, 581, 582, 583, 584.

*International development:* three courses including REN 595 and two related electives.

*Alternative dispute and conflict resolution processes:* three courses including LRS 545, 546, 581, 590, 591, and PSC 420 or 432.

*Nondesignated specialization:* three courses in an area that satisfies the student's individual professional goals—e.g., computer science or statistics; economics or social policy; law and legal processes; or workplace issues such as alcohol and drug abuse, sexual or age discrimination, or racism.

#### LRS Courses

##### Labor and Industrial Relations

#### 432 Industrial Sociology (I or II, 3)

**520 Labor Union Government and Structure (I or II, 3)** Structure, functions, responsibilities, and programs of unions and union leadership. Emphasis on policies and decision making. Evaluation of labor and management performance. Consideration of administrative problems associated with growth of white collar unions. (Lec. 3) *Pre: credit or concurrent enrollment in 544.* Molloy

**521 (or PSC 521) International and Comparative Trade Unions and Labor Relations (I or II, 3)** Comparative labor and industrial relations systems, including union, management, and government functions and roles; also the functions of international organizations in labor relations. (Lec. 3) *Pre: 544 or permission of Labor Research Center director.* Rothstein or Schmidt

**526 (or ECN 526) Economics of Labor Markets (I or II, 3)** The theory of labor market behavior, and application of theory for public policy analysis in areas such as discrimination, unemployment, and education. *Pre: ECN 125 and 126 or 590 or equivalent.* Staff

**531 Employment Law (I or II, 3)** Analysis of legislation protecting worker health, employment, income security, including OSHA, workers' compensation, equal opportunity, fair labor standards, Walsh-Healy and Davis-Bacon, pension funds, unemployment compensation, and social security. (Lec. 3) *Pre: permission of chairperson.* Tabor

**533 Negotiating Pension, Health, and Employee Assistance Programs (I, II, or SS, 3)** An analysis of employee assistance plans (EAPs), health fringe benefits, and pension plans and their negotiation within both the private and public sectors. (Lec. 3) *Pre: permission of instructor and Labor Research Center director.* Staff

**534 (or ECN 534) Information Sources and Uses in Labor Relations and Labor Economics (I or II, 3)** Analysis and use of data and information sources specific to the professional fields of labor and industrial relations and labor economics. A major project utilizing personal computer software is required. (Lec. 3) *Pre: 526 and QBA 500 and 530 or permission of instructor. Not for graduate credit for M.B.A. or M.S. in accounting students.* Staff

**541 Labor Relations Law (I or II, 3)** Legal framework for private and public sector collective bargaining. Regulation of activities with emphasis on individual rights, collective rights, and policy considerations of federal and state courts, the NLRB, and state labor boards in determining society's rights. Case studies. (Lec. 3) *Pre: 544 or permission of instructor.* Grossman

**542 Labor Relations and Collective Bargaining** (*I or II, 3*) Collective bargaining literature, theories, and practice. Bargaining approaches, techniques, and dynamics will be stressed through the analysis of comprehensive case studies. (*Lec. 2, Lab. 2*) *Pre: 541 and 544 or permission of Labor Research Center director.* Schmidt

**543 Labor Relations and Collective Bargaining: Public Sector** (*I or II, 3*) Public sector (state, municipal, federal, police, fire, K–12 education, and higher education) collective bargaining theory, practice, and legal foundations. Comprehensive case studies. (*Lec. 3*) *Pre: credit or concurrent enrollment in 542 or permission of Labor Research Center director.* Grossman

**544 (or HIS 544) Colloquium in Worker History** (*I or II, 3*) Selected topics in American worker history with an emphasis on the most recent literature in the field. (*Sem. 3*) *Pre: graduate standing or permission of instructor.* Molloy

**545 Labor Dispute Settlement** (*I or II, 3*) Reading, procedures, and cases in the settlement of labor disputes in both private and public sectors. Emphasis on arbitration, mediation, and fact-finding. (*Lec. 3*) *Pre: 541 and 542 or permission of Labor Research Center director.* Staff

**546 Alternative Dispute Resolution Processes and Applications** (*I, II, or SS, 3*) Examination of mediation, fact-finding, arbitration, and other conflict resolution processes as alternatives to litigation in a variety of dispute situations, e.g., community, environmental, divorce, landlord-tenant, prison, racial, commercial. (*Lec. 3*) *Pre: permission of instructor.* Staff

**579 (or EDC 579) Labor Relations and Collective Bargaining in Education** (*I, II, or SS, 3*) Collective bargaining in public and private educational sectors, K–12, higher education; literature, theory, practice, and legal foundations in education. Comprehensive case studies will be used. (*Lec. 3*) Croasdale

**580 Professional Seminar: Labor and Industrial Relations** (*II, 3*) Advanced labor relations seminar of variable coverage and focus; adjusted yearly to consider most recent labor relations developments. Major research paper required. (*Sem. 3*) *Pre: final semester graduate standing in labor and industrial relations and permission of Labor Research Center director.* Schmidt

**581 Internship: Labor and Industrial Relations** (*I, II, and SS, 3–6*) Variable length internship with a trade union, a public or private sector personnel or industrial relations department, or a governmental administrative or regulatory agency, under the supervision of both an LRC faculty member and a member of the affiliated organization. May be taken as one 6-credit unit or two 3-credit units. *Pre: graduate standing in labor and industrial relations and permission of Labor Research Center director.* Schmidt

**590, 591 Directed Readings and Research in Labor and Industrial Relations** (*I, II, and SS, 3 each*) Readings and research under the direction of LRC-associated faculty to meet individual student requirements. *Pre: graduate standing in labor and industrial relations and permission of Labor Research Center director and instructor.* Staff

## Languages

The University offers Master of Arts degrees in comparative literature studies, French, and Spanish.

### Comparative Literature Studies M.A.

See Comparative Literature Studies on page 45.

### French M.A.

See French on page 57.

### Spanish M.A.

See Spanish on page 102.

### GER Courses German

**409 History of the German Language** (*I, 3*)  
**421 Business German** (*I, 3*)  
**441, 442 German Literature of the Eighteenth Century** (*I and II, 3 each*)  
**451, 452 German Literature of the Nineteenth Century** (*I and II, 3 each*)  
**485, 486 Special Studies** (*I and II, 1–3 each*)  
**497 Directed Study** (*I and II, 1–3*)  
**498 Directed Study** (*I and II, 3*)

**586 Seminar in German Studies** (*I, II, and SS, 1–3*) Topics in German literature and civilization. *Pre: graduate standing or permission of instructor. May be repeated with different topics.* Staff

**598 Directed Studies** (*I, II, and SS, 1–3*) Individual research on problems of special interest. *Pre: graduate standing, acceptance of project by a staff member, and permission of chairperson. May be repeated with different topics.* Staff

**987, 988 German Play Production** (*SS, 1 each*) Study and production of a German play or plays. *Pre: 215 and 216 or equivalent. Students may enroll concurrently in 485, 486.* Staff

### GRK Courses Greek

**497, 498 Directed Study** (*I and II, 1–6 each*)

### ITL Courses Italian

**408 The Italian Language** (*I or II, 3*)  
**455 Selected Italian Authors** (*I or II, 3*)  
**465 Topics in Italian Literature** (*I or II, 3*)  
**480 Business Italian** (*I or II, 3*)  
**481, 482 The Works of Dante Alighieri** (*I and II, 3 each*)  
**497, 498 Directed Study** (*I and II, 3 each*)

### LAT Courses Latin

**497, 498 Directed Study** (*I and II, 1–6 each*)

### LIN Courses Linguistics

**420 Second-Language Acquisition** (*II, 3*)  
**431 Applied Linguistics in the Language Laboratory** (*I, 1*)  
**497, 498 Directed Study** (*I and II, 3 each*)

*The following are related, specialized courses in historical linguistics offered in the Department of English and in the Department of Modern and Classical Languages and Literatures.*

ENG 530 History of the English Language  
 FRN 503 History of the French Language  
 GER 409 History of the German Language  
 ITL 409, 410 History of the Italian Language

### RUS Courses Russian

**460, 461 The Russian Novel** (*I and II, 3 each*)  
**497, 498 Directed Study** (*I and II, 3 each*)

## Library and Information Studies

M.L.I.S.  
 401-792-2947

### Graduate Faculty

*Director, Graduate School of Library and Information Studies:* Professor Elizabeth Futas, Ph.D., 1980, Rutgers—The State University

*Assistant to the Director for Regional Studies:* Associate Professor Fay Zipkowitz, D.A., 1977, Simmons College

Associate Professor C. Herbert Carson, Ph.D., 1988, Syracuse University  
 Associate Professor Stewart P. Schneider, Certificate in Advanced Librarianship, 1974, Columbia University

Associate Professor Leena Siitonen, Ph.D., 1984, University of Pittsburgh

Associate Professor Jonathan S. Tryon, Certificate in Advanced Librarianship, 1974, Columbia University; J.D., 1981, Suffolk University

Assistant Professor E. Gale Eaton, Ph.D., 1990, University of North Carolina, Chapel Hill

Assistant Professor Donna Gilton, Ph.D.,  
1988, University of Pittsburgh  
Assistant Professor Cheryl McCarthy, Ph.D.,  
1990, Simmons College  
Assistant Professor Emerita Patricia E.  
Jensen, Ph.D., 1983, University of  
Connecticut

### Specializations

The overall goal of the school is to educate librarians who will not only function effectively, but also demonstrate the capacity to affect the course of librarianship. The Graduate School of Library and Information Studies prepares students for professional service in libraries and information agencies by offering an ALA-accredited program leading to the Master of Library and Information Studies (M.L.I.S.) degree. It also provides an opportunity for students to pursue simultaneously master's degrees in library and information studies and in history or public administration. The school library media specialization is accredited by NASDTEC.

Through consultation with advisors, students prepare for careers in academic, school, public, or special libraries. They also may plan for specialization in areas such as children's service, reference and bibliography, cataloging, special collections, media programs, information science, automation, administration, young adult services, and library history.

### Master of Library and Information Studies

*Admission requirements:* bachelor's degree (B average) and GRE (combined verbal and quantitative scores of 1000) or MAT at the 50th percentile. GRE or MAT waived for applicants with a master's degree. The completed application package should be received by November 15 for spring admission, April 15 for summer admission, and July 15 for fall admission.

*Program requirements:* 42 credits consisting of LSC 501, 502, 503, 504, 505, or 506; 21 credits of electives of which up to nine may be taken in courses outside library science when relevant to the student's specialization; one course with major paper requiring significant independent research; and a written comprehensive examination. Up to 24 hours may be taken at the regional centers at the University of Massachusetts in Amherst or Boston and at the University of New Hampshire at Durham. No more than six credits or two courses may be taken in nonmatriculating status for transfer into the degree program.

### Cooperative Program (M.A. in History and M.L.I.S.)

By proper selection of course work, a student may simultaneously earn the degrees of Master of Arts in history and Master of Library and Information Studies.

*Admission requirements:* GRE (subject test desirable) and other requirements listed for history and library science. Applicant must apply and be accepted in both programs. The application to each program must indicate history/library and information studies as the field of specialization.

*Program requirements:* students must submit individual programs of study for each degree that satisfy specific core requirements for these programs. Since a maximum of six credits may be jointly used to satisfy degree requirements, a minimum of 66 credits total is required to satisfy the requirements for both degrees.

### Cooperative Program (M.P.A. and M.L.I.S.)

A second cooperative program permits joint enrollment in the Master of Library and Information Studies and Master of Public Administration programs. The integrated pursuit of the two degrees makes it possible for nine credits of appropriately selected course work from one program to serve as electives in the other, and for six credits to be applied in the opposite direction. Thus, when planned and taken jointly, the two programs can be completed with a total of 63 credits.

*Admission requirements:* GRE and other requirements listed for M.L.I.S. and M.P.A. Applicant must apply and be accepted in both programs. The application to each program must indicate M.L.I.S./M.P.A. as the field of specialization.

*Program requirements:* each student must complete the required core courses for both programs plus three credits of PSC 590 for the M.P.A. After consultation with, and approval of, both departments, students must file separate programs of study for each degree, indicating the courses to be jointly counted. Each student must pass the separate comprehensive examination for each degree. A student who fails to complete one of the programs may, of course, complete the other in accordance with the separate program of study.

### LSC Courses Library and Information Studies

**501 Foundations of Library and Information Science (I and II, 3)** Overview of the field covering the language and literature of librarianship; the history and functions of libraries; the nature of various types of libraries, the profession, operations, and new technologies. (Lec. 3) *Pre: graduate standing or permission of instructor.* Eaton, Zipkowitz, and Carson

**502 Library Administration (I and II, 3)** The scientific analysis of library administration ranging from the community survey and formulation of goals and objectives to case studies on public and technical services, staffing and personnel, and buildings. (Lec. 3) Siitonen and Zipkowitz

**503 Collection Development (I and II, 3)** Introduction to process, practices, and problems of collection building, maintenance, and evaluation regardless of format or subject of material, type of institutional setting, or community or client group served. (Lec. 3) Futas and Tryon

**504 Reference and Information Services (I and II, 3)** Practical experience in the use of basic information sources with readings and discussion on the philosophy and administrative aspects of reference work. (Lec. 3) Gilton and Futas

**505 Organization of Library Materials (I and II, 3)** Introduction to the principles and practice of descriptive and subject cataloging and classification systems with an introduction to Library of Congress classification. Includes OCLC searching and tagging. (Lec. 3) Staff

**506 Technical Services (I or II, 3)** Principles and policies in the acquisition, organization, conservation, and circulation of materials in libraries and information centers. Includes examination of automation of library processes. (Lec. 3) *Pre: 501.* Zipkowitz

**510 History of Books and Printing (I or II, 3)** The art and craft of book production through the ages; printers, methods, and materials with consideration given to the role of the book in cultural development. (Lec. 3) Tryon

**512 History of Libraries and Librarianship (I or II, 3)** The development of libraries and librarianship within a cultural, social, and economic context from antiquity to the present. (Lec. 3) Tryon

**513 Intellectual Freedom and Censorship (I or II, 3)** Historical development and current status of the concept of intellectual freedom and the restraints that past and present societies have imposed on it. Special attention given to the librarian's role in defense of intellectual freedom. (Lec. 3) Tryon

**520 School Library Media Services (I or SS, 3)** The role of the library media specialist as teacher information specialist and instructional consultant, with emphasis on creating instructional programs and services in schools. Summer or fall semester prior to practicum. *Pre: completion of 21 hours including core courses, 501–505, or permission of instructor.* McCarthy

**521 Public Library Service (I or II, 3)** Methods for management and planning in public libraries for creating programs, and for evaluating services and their effects on the public served. The identification of alternative solutions to budgeting and personnel management problems. (Lec. 3) *Pre: 502.* Siitonen and Zipkowitz

**522 College and University Library Service (II, 3)** Study of the functions, organization, management, and services of college and university libraries. (Lec. 3) *Pre: 502.* Tryon and Zipkowitz

**523 Special Library Service (I or II, 3)** Organization, management, and procedures as they apply to special libraries with particular emphasis on the diversity of special library functions. (Lec. 3) Pre: 502. Kellerman and Stankus

**524 Library Instruction: Philosophy, Methodology, and Materials (II, 3)** An introduction to all aspects of instructing a diverse clientele in effective library use. Philosophy, cognition aspects, methodologies, media and administration, and coordination and evaluation of library instruction will be considered. (Lec. 3) Pre: 504 or permission of instructor. Gilton

**528 Media in the Library (I or II, 3)** The role of multimedia materials in library and information settings, including the selection, evaluation, organization, and utilization of audiovisual hardware and software, and an introduction to emerging communication technologies. (Lec. 3) Carson

**529 Theory and Production of Library Media Communications (I or II, 3)** Introduction to the design and production of graphic, photographic, audio, video, and computer-based materials for library and information environments through the application of basic communication, perception, and learning theories. (Lec. 3) Carson

**530 Reading Interests of Children (I or II, 3)** A survey of children's literature as it relates to the reading interests and information needs of children. Emphasis is on collection building, reference, reading guidance, and book promotion. (Lec. 3) Pre: 503 or permission of instructor. Eaton

**531 Reading Interests of Young Adults (I or II, 3)** Overview of young adult literature in the context of the special interests and information needs of adolescence. Emphasis on the building, use, and promotion of the young adult collection. (Lec. 3) Pre: 503 or permission of instructor. Eaton

**535 Public Library Services to Children and Young Adults (II, 3)** Public library services to children and young adults, with emphasis on the development of programs to meet library goals and objectives. (Lec. 3) Pre: 502 or permission of instructor. Eaton

**536 Storytelling (I or II, 3)** Selection, adaptation, and presentation of stories for children of all ages, including attention to sources of materials, planning the story hour, and training and practice in the art of storytelling. (Lec. 3) Daigneault

**537 Health Sciences Librarianship (II, 3)** Serves as an introduction to the field. Covers the literature, vocabulary, computer applications, reference tools, information retrieval, and environments relating to health sciences libraries. (Lec. 3) Pre: 502 and 504 or permission of instructor. Kellerman

**538 Law Librarianship (I, 3)** Introduction to legal bibliography and research and to a broad range of problems involved in the administration and operation of various kinds

of law libraries. (Lec. 3) Pre: 502 and 504 or permission of instructor. Svengalis

**539 Business Reference (I, 3)** An introduction to all aspects of business reference sources and business information services, including unique aspects of business information services and resources and companies, industry, statistical, investment, and other information. (Lec. 3) Pre: 504. Gilton

**540 Library Materials in the Humanities (I or II, 3)** Library resources in the humanities, including the major works, serial publications, and reference and bibliographical materials. (Lec. 3) Pre: 503 and 504. Schneider

**541 Library Materials in the Social Sciences (I or II, 3)** Library resources in the social sciences, including the major works, serial publications, and reference and bibliographical materials. (Lec. 3) Pre: 503 and 504. Schneider

**542 Library Materials in Science and Technology (I or II, 3)** Library resources in science and technology, including the major works, serial publications, and reference and bibliographical materials. (Lec. 3) Pre: 503 and 504. Carson

**543 Government Publications (I or II, 3)** Survey of the publishing activities and publications of national, state, and local governments with emphasis on the publications of the United States government. (Lec. 3) Pre: 504. Schneider and Gilton

**544 Information Science for Librarians (I or II, 3)** An introduction to the interdisciplinary study of information science related to information (data) collection, analysis, processing, transmission, utilization, and communication, with emphasis on bibliographic data and its retrieval in modern libraries and information centers. (Lec. 3) Pre: 502 and 504 or permission of instructor. Siitonen

**545 Indexing and Abstracting (I or II or SS, 3)** Principles and techniques of indexing for the purpose of information storage and retrieval. Includes periodical indexing, book indexing, automatic indexing, abstracting, and thesaurus construction. (Lec. 3) Pre: 504. Kellerman

**546 Computer Systems in Library Automation (I or II, 3)** Introduction to principles of systems analysis and the tools of analysis. Study of computer hardware and software and the application of new technologies to library operations and services. (Lec. 3) Pre: 501 or permission of instructor. Staff

**547 Online Searching and Services (I or II, 3)** Introduction to computerized information retrieval and the provision of computerized information services in libraries, including hands-on experience. (Lec. 2, Lab. 1) Pre: 501 and 504. Schneider and Siitonen

**548 Microcomputer Applications in Library and Information Services (I or II, 3)** Selection, evaluation, and integration of hardware and software specific to functions

of different types of libraries and information centers. (Lec. 3) Pre: 501 or permission of instructor. Siitonen and Carson

**549 Information Storage and Retrieval (I or II, 3)** Theory and methods of analyzing, storing, and retrieving primarily bibliographic information and their applications in libraries and information services. Operation, monitoring, and evaluation of manual and computerized retrieval systems. (Lec. 2, Lab. 1) Pre: 501. Siitonen

**550 Advanced Cataloging (I or II, 3)** Theory and problems in descriptive and subject cataloging and classification with emphasis on the use of Library of Congress subject headings and classification. Includes editing of original and copy cataloging for OCLC. Emphasis is on microforms, serials, rare books, music and sound recordings. (Lec. 3) Pre: 505. Zipkowitz

**561 Library Effectiveness: Research and Evaluation (I, 3)** Introduction to types and methods of research, applications of published research and research techniques to the evaluation and improvement of library and information services. (Lec. 3) Pre: 15 hours of library science or permission of instructor. Eaton

**562 Administration of Special Collections, Archives, and Manuscripts (I, 3)** Principles and techniques for administering manuscript and archival repositories, including acquisition policies, appraisal criteria, methodology, and preservation practices. (Lec. 3) Pre: core courses or permission of instructor. Maslyn

**564 Introduction to Library Preservation (I or II, 3)** Organization, management, principles, and techniques as they apply to the development and administration of a library preservation program. Includes causes of deterioration of materials, deacidification, and reformatting and selecting for preservation. (Lec. 3) Dodge

**565 Rare Book Librarianship (I or II, 3)** Organization, management, principles, and techniques as they apply to the development and administration of rare book collections. (Lec. 2, Lab. 2) Pre: 510 or permission of instructor. Tryon

**571 Database Management Systems for Information Services (I or II, 3)** Provides concepts of database management systems (DBMS) for the design and use of bibliographic and nonbibliographic databases. Includes DBMS models, query processing, file organization; security, accuracy, and privacy of databases, and evaluation of DBMSs. Pre: 548 or equivalent knowledge and permission of instructor. Siitonen

**591, 592, 593 Independent Work (By appt., 1–3 each)** Supervised reading or investigation in areas of special interest to students who obtain written approval for such study prior to registration for the semester for which it is proposed. Pre: 18 hours of library science with a B average. May be repeated for a maximum of 3 credits. Staff

**595 Professional Field Experience (I and II, 1–3)** Directed field experience applying theory to practice in libraries, information centers, and related organizations under the joint supervision of a member of the faculty and the professional staff of the cooperating institutions. (45 hours per credit) *Pre: completion of at least 18 hours of library science with a B average. May be repeated for a maximum of 3 credits.* Staff

**596 School Library Media Practicum and Seminar (II, 9)** 300-hour, 10-week full-time directed field experience in two school library media centers, elementary and secondary, demonstrating competencies of the library media specialist. Biweekly seminar class also required. *Pre: 520 and completion of 30 hours of library science or permission of instructor.* McCarthy

**597 Selected Topics (I and II, 3)** Selected topics in library and information studies of current and special interest not covered in existing course offerings. Topics announced prior to each offering. (Lec. 3) *Pre: 501 or permission of instructor.* Staff

## Manufacturing Engineering

M.S.

401-792-2455

### Graduate Faculty

*Chairperson:* Professor Winston A. Knight, Ph.D., 1967, Birmingham University

*Director of Graduate Studies:* Professor Peter Dewhurst, Ph.D., 1973, University of Manchester

Professor Geoffrey Boothroyd, Ph.D., 1962, D.Sc., 1974, University of London

Associate Professor William D. Lawing, Jr., Ph.D., 1965, Iowa State University

Associate Professor David M. Shao, Ph.D., 1970, State University of New York, Buffalo

Assistant Professor Manbir Sodhi, Ph.D., 1991, University of Arizona

Adjunct Professor Charles C. Reynolds, Ph.D., 1963, Massachusetts Institute of Technology

### Specializations

Fundamentals of manufacturing processes, manufacturing automation, product design for efficient manufacture, and the organization of manufacturing systems.

### Master of Science

*Admission requirements:* GRE (for graduates of non-U.S. universities only) and B.S. degree in industrial, manufacturing, or mechanical engineering. An applicant with a B.S. degree in another field of engineering, mathematics, physics, chemistry, or computer science will be considered; such applicants will be required to complete some deficiency courses.

*Program requirements:* 30 credits including thesis (six credits); IME 542; IME 544 and 549 or 591, 592, and a graduate elective; three credits each from the areas of fundamentals of manufacturing processes and manufacturing properties of materials, control and organization of manufacturing systems, and computer systems in manufacturing engineering and design. IME 340 or equivalent is a prerequisite.

### Financial Aid

A number of graduate and research assistantships are available for qualified graduate students.

### Doctor of Philosophy

See Applied Mathematical Sciences on page 28.

## IME Courses Industrial and Manufacturing Engineering

**404 Engineering Economy (I and II, 3)**

**411 Probability for Engineers (I, 3)**

**412 Statistics for Engineers (II, 3)**

**430 Design and Analysis of Compensation Systems (II, 3)**

**432 Operations Research: Deterministic Models (I, 3)**

**433 Operations Research: Stochastic Models (II, 3)**

**435 Introduction to Operations Research (I and II, 3)**

**441 Metal Castings (II, 3)**

**443 Machining and Machine Tools (II, 3)**

**444 Assembly and Handling Automation (I, 3)**

**446 (or MCE 446) Metal Deformation Processes (II, 3)**

**449 (or MCE 449) Product Design for Manufacture (I, 3)**

**450 Computer-Aided Industrial and Manufacturing Engineering (I, 3)**

**451 Industrial Engineering Systems (II, 3)**

**491, 492 Special Problems**

(I and II, 1–6 each)

**500 Network Application in Industrial Engineering (II, 3)** Industrial systems problems that can be formulated in terms of flows in networks. Critical path scheduling, transportation problems, allocation, sequencing, line balancing, etc. (Lec. 3) *Pre: 432 or permission of instructor. In alternate years.* Shao

**513 Statistical Quality Assurance (I, 3)** Topics in statistical quality control systems. Single, multiple, and sequential sampling. Design and analysis of a wide variety of statistical control systems used in conjunction with discrete and continuous data, for several kinds of data emission. (Lec. 3) *Pre: 412 or equivalent.* Staff

**514 Special Topics in Statistical Quality Assurance (II, 3)** Quality control evaluation and monitoring systems for short-run production processes; analysis of critical specifications in small limited sample

opportunities; sequential analyses; statistical procedures for troubleshooting; small sample strategies. (Lec. 3) *Pre: 412 or equivalent or permission of instructor.* Staff

### 525 Simulation

See Computer Science 525.

**533 Advanced Statistical Methods for Research and Industry (I, 3)** Estimation and testing; regression and correlation; analysis of variance and related topics. Applications in industrial operations and engineering research. (Lec. 3) *Pre: 411 or permission of instructor.* Lawing

**540 Production Control and Inventory Systems (I, 3)** Theory and practice of industrial production control and inventory systems. A broad spectrum of mathematical models for static, dynamic, perpetual, and periodic inventory systems as they affect and relate to production. (Lec. 3) *Pre: 432 or permission of instructor.* Staff

**541 Materials Processing and Metrology II (I, 3)** Continuation of 340. Engineering analyses in the processing of materials. Dynamic coupling, tool-work-piece interaction, energy and thermal analysis; mechanics of material removal and displacements, advanced topics in mechanical electrical systems for processing of materials. (Lec. 3) *Pre: 440 or permission of instructor.* Staff

**542 Introduction to Computer-Aided Manufacturing (I, 3)** Use of computers in manufacturing. Planning and control of manufacturing facilities and operations. Group technology, flow lines, optimization of machining conditions, numerical and adaptive control, automation, robotic applications. (Lec. 3) *Pre: 443 or permission of instructor.* Knight

**543 Fundamentals of Machining (II, 3)** Fundamental treatment of the mechanics and economics of metal machining and grinding. Includes an introduction to numerical control and computer-aided programming of CNC machine tools. (Lec. 3) *Pre: CVE 220 and IDE 340 or permission of instructor.* Boothroyd, Dewhurst, and Knight

**544 Automatic Assembly (I, 3)** Types and economics of automatic assembly systems. Analysis of automatic feeding and orienting techniques for small parts. Application of robots in assembly. Economics of assembly systems for printed circuit boards. (Lec. 3) *Pre: 240 or permission of instructor. Not for graduate credit for students with credit in 444.* Boothroyd and Dewhurst

**545 Manufacturing Systems: Analysis, Design, Simulation (I, 3)** Problems in manufacturing system analysis and design. Quantitative models and simulation methods applied to production planning, control, scheduling, resource allocation, and decision making in various types of manufacturing systems. (Lec. 3) *Pre: 433 or permission of instructor.* Shao

**546 Advanced Metal Deformation Processes (II, 3)** Theory of metal flow under different loading conditions. Prediction of metal forming process capabilities. Advanced topics include effects of anisotropy and mechanics of powder forming. (*Lec. 3*) *Pre: 340 or permission of instructor. Not for graduate credit for students with credit in 446.* Dewhurst

**549 (or MCE 549) Advanced Product Design for Manufacture (I, 3)** Techniques for analyzing product structures for ease of assembly and manufacture. Considers mechanical and electronic products and choice of materials and processes. A design project and term paper are required. *Pre: 240 or 340 and credit or current enrollment in 444 or permission of instructor. Not for graduate credit for students with credit in 449.* Dewhurst or Boothroyd

**550 Design for Producibility (II, 3)** Addresses the capabilities of primary shape-generating processes. Concentration on manufacturability guidelines and on the effects of design decisions on material choice, processing times, and tooling costs. (*Lec. 3*) *Pre: 449 or 549.* Knight or Dewhurst

**555, 556 Engineering Applications of Mathematical Programming I, II (I and II, 3 each)** Sensitivity analysis and pricing problems, practical problems in degeneracy and duality, decomposition methods for large-scale systems, applied convex, integer, nonlinear, and quadratic programming methods. An introduction to stochastic programming. (*Lec. 3*) *Pre: 432 for 555 or permission of instructor; 555 for 556 or permission of instructor. In alternate years.* Staff

**565 Theory of Scheduling (II, 3)** Sequencing problems, finite sequencing for a single machine n/m job shop problems with analytical and heuristic procedures, networks applied to scheduling, queuing systems in scheduling, probabilistic scheduling problems. Survey of selected literature. (*Lec. 3*) *Pre: 432 or permission of instructor. In alternate years. Next offered 1993-94.* Shao

**591, 592 Special Problems (I and II, 1-6 each)** Advanced work under supervision of a staff member arranged to suit the individual requirements of the student. (*Lec. or Lab. according to the nature of the problem*) *Pre: permission of chairperson. May be repeated for a maximum of 12 credits.* Staff

**599 Master's Thesis Research (I and II)** Number of credits is determined each semester in consultation with the major professor or program committee. *S/U credit.*

**610 Topics in Applied Queuing Theory (I, 3)** Poisson and Erland queues, imbedded chains, M/G/1 and G/M/1 queues, and related topics in queuing theory. Analysis of a wide variety of queues with an applications orientation. (*Lec. 3*) *Pre: 433 or permission of instructor. In alternate years. Next offered 1993-94.* Staff

**634 Design and Analysis of Industrial Experiments (II, 3)** Further development of topics in analysis of variance. Randomized blocks, Latin squares and related designs, factorial experiments, confounding and fractional replications, and split-plot designs. Design and analyses of engineering experiments. (*Lec. 3*) *Pre: 533.* Lawing

**635 (or EST 635) Response Surfaces and Evolutionary Operations (II, 3)** Methods of determining the response surface for multiple factors over a specified range and techniques for seeking an optimum. First- and second-order response surfaces. Rotatable second-order design. Central composite rotatable designs. Multivariable EVOP programs and other topics in evolutionary operations. (*Lec. 3*) *Pre: 533 or equivalent.* Lawing

**660 Methods of Optimization (II, 3)** Methods of optimization: indirect, direct elimination, climbing. Geometric programming. Problems and other topics in applied optimization. (*Lec. 3*) *Pre: CSC 500 and permission of instructor. In alternate years. Next offered 1993-94.* Staff

**691, 692 Advanced Special Problems in Industrial Engineering (I and II, 1-6 each)** Advanced work under the supervision of a staff member arranged to suit the individual requirements of the student. (*Lec. or Lab. according to nature of problem*) *Pre: permission of chairperson. May be repeated for a maximum of 12 credits.* Staff

## Marine Affairs

M.A., M.M.A.  
401-792-2596

### Graduate Faculty

*Chairperson:* Professor Lawrence Juda, Ph.D., 1973, Columbia University

*Director of Graduate Studies:* Associate Professor Dennis W. Nixon, J.D., 1975, University of Cincinnati; M.M.A., 1976, University of Rhode Island

Professor Niels West, Ph.D., 1973, Rutgers—The State University

Associate Professor Richard H. Burroughs, Ph.D., 1974, Massachusetts Institute of Technology and Woods Hole Oceanographic Institution

Associate Professor Bruce E. Marti, Ph.D., 1982, University of Florida

Assistant Professor William R. Gordon, Jr., Ph.D., 1987, Texas A&M University

Assistant Professor Gerald H. Krausse, Ph.D., 1975, University of Pittsburgh

Adjunct Professor Thomas Kitsos, Ph.D., 1992, University of Illinois

Adjunct Professor Claiborne D. Pell, M.A., 1946, Columbia University

Adjunct Professor Gerald Seifert, J.D., 1964, Indiana University; M.M.A., 1978, University of Rhode Island

Adjunct Associate Professor Jens C. Sorensen, Ph.D., 1978, University of California, Berkeley  
Professor Emeritus Lewis M. Alexander, Ph.D., 1949, Clark University  
Professor Emeritus John A. Knauss, Ph.D., 1959, University of California

### Specializations

Coastal zone management, marine transportation and port planning, fisheries law and management, international marine policy and law, marine geography.

### Master of Arts (M.A.)

*Admission requirements:* GRE and bachelor's degree in related science or social science. For international students, minimum TOEFL score of 575. Full-time applicants are admitted for September only.

*Program requirements:* thesis and MAF 482, 502, 577, 651, 652; MAF 511 or appropriate oceanography substitute; REN 514 or appropriate resource economics substitute; plus a minimum of 18 elective credits for a total of 45 credits.

### Master of Marine Affairs (M.M.A.)

*Admission requirements:* prior graduate degree or five years of equivalent experience in marine areas. For international students, minimum TOEFL score of 575. Applicants are admitted for September only.

*Program requirements:* nonthesis program; MAF 577, 589, 651, 652; REN 514; MAF 511 or appropriate oceanography substitute; plus 12 elective credits for a total of 30 credits; written comprehensive examination.

### MAF Courses Marine Affairs

**410 Problems in Geography and Marine Affairs (II, 3)**

**413 (or APG 413) Peoples of the Sea (I, 3)**

**456 Polar Resources and Policy (I, 3)**

**461 Coastal Zone Uses (I, 3)**

**465 GIS Applications in Coastal and Marine Management (II, 3)**

**471 Island Systems (II, 3)**

**472 Marine Recreation Management (II, 3)**

**482 Quantitative Methods in Marine Affairs (II, 3)**

**484 Environmental Analysis and Policy in Coastal Management (II, 3)**

**491, 492 Special Problems (I and II, 3 each)**

**499 Directed Study (I and II, 1-3)**

**502 Research Methods in Geography and Marine Affairs (II, 3)** Emphasis on the application of alternative research methods utilized in a typical interdisciplinary study. Development of specific research projects. *Pre: 482 or permission of chairperson. (Lec. 3)* Marti

**511 Ocean Uses and Marine Science (II, 3)** Introduction to selected ocean uses focusing on the interplay of public policy and marine science. Emphasis on policy implications of uses such as resource and energy extraction and waste disposal. (Lec. 3) Burroughs

**512 (or PSC 512) Seminar in Marine Science Policy and Public Law (II, 3)** Examination of the interplay of science, policy, and law in the formulation and implementation of domestic policy in areas such as waste management and the environment. Burroughs

**516 (or CPL 516) Seminar on the Urban Waterfront (I, 3)** The urban environment, its evolution, structure, and function as it relates to the waterfront. Topics on policy, management, and utilization on the local and regional level will be covered. Field trip and student project required. *Pre: credit or concurrent enrollment in marine affairs or community planning or permission of instructor.* Krausse

**520 Seminar in Coastal Margin Management (II, 3)** Nature of oil, gas, and other mineral resources on the outer continental shelf, public and private sector decisions, and environmental issues are reviewed. Emphasis on the utility of data for policy development. (Sem. 3) Burroughs

**521 Coastal Zone Law (I, 3)** Examination of the authority of different levels and agencies of government to make decisions affecting coastal regions. Survey of existing and proposed state and national legislation affecting coastal regions. (Lec. 3) Nixon

**523 Fisheries Law and Management (II, 3)** Examination of the relationship between law and fisheries policy on the international and national level, law relating to fisheries, jurisdictional levels, function of law in implementing fisheries management policy. (Lec. 3) Nixon

**526 LANDSAT Remote Sensing and Analysis (II, 3)** Theory and application of the LANDSAT remote sensing system and geographical information systems emphasizing coastal resource surveillance. Development and interpretation of supervised and unsupervised classifications from digitized reflectance values obtained from the MS and TM scanners. *Pre: 482 or permission of instructor.* West

**530 Coastal Area Management Seminar (SS, 3)** Examines coastal resource problems from a spatial approach, emphasizing present and potential user conflicts and the manner in which they have been addressed here and abroad. (Sem.) *Pre: credit or concurrent enrollment in MAF, CPL, or REN, graduate standing, or permission of instructor.* West

**562 Admiralty Law (I, 3)** Fundamentals of admiralty law: collisions at sea, bills of lading, marine insurance, and rights of seamen. Case studies of marine transportation problems and their resolution by law. (Lec. 3) Nixon

**563 Maritime Transportation (II, 3)** Passenger and commodity transportation. Analysis of the relationship between transportation services and the spatial distribution of activities. Emphasis on multimodal transport and bulk commodities. (Lec. 3) *Pre: senior or graduate standing or permission of instructor.* Marti

**564 Port Operations and Policy (II, 3)** Analysis of coastal and international trade routes and the response of ports. Special emphasis on the container revolution, liquid natural gas transportation, and deep-water ports for supertankers. (Lec. 3) Marti

**571 Marine Geography (I, 3)** The marine region as a unique complex of physical and cultural elements. The purpose is to analyze functional relationships within the region and to assess forms of regional organization and control. (Lec. 3) Staff

**572 Management of Ocean Regions (II, 3)** A global study of the nature and use of ocean basins, semi-enclosed seas, and other marine areas, with special emphasis on regional arrangements and regimes. (Lec. 3) *Pre: 571 or permission of chairperson. In alternate years.* Staff

**577 (or PSC 577) International Ocean Law (I, 3)** Principles of international law as they relate to ocean management problems. Jurisdiction in the territorial sea, contiguous zones, and the deep seabed will be examined within the international legal framework. (Lec. 3) *Pre: 312, CPL 434, or permission of instructor.* Juda

**578 International Ocean Organizations (II, 3)** International organizations involved in marine-related activities, including their planning, management, and regulatory and assistance functions. Attention to the impact of these organizations on national policies in the developed and developing worlds. (Lec. 3) *Pre: 577 or permission of instructor.* Juda

**579 Marine Jurisdictional Issues (II, 3)** Examination and analysis of national controls in the oceans, including international and domestic maritime boundaries, types of offshore zones, and claims to special jurisdictional rights. (Lec. 3) *Pre: 571 or 577 or permission of instructor.* Staff

**582 Estuarine Policy (I, 3)** Policy options, governing structures, and management techniques for estuarine areas are considered with special attention to the effectiveness of the resulting approaches. (Lec. 3) Burroughs

**586 Environmental Impact Assessment and Analysis (I, 2)** Centers on an impact assessment of a proposed coastal community project and includes the development of project alternatives, associated impacts, preparation of a public hearing, and final report. Relevant methods and procedures are reviewed. (Lec. 2) *Pre: matriculated graduate student or permission of instructor. 586 may not be used for program credit unless 587 is completed in the same academic year.* West

**587 Environmental Assessment Meeting and Report (II, 2)** Continuation of 586, which must be taken in the same academic year. Focus is on the public meeting and completion of written report prepared in 586. (Workshop 3) *Pre: 586.* West

**589 Master's Project Research (I or II, 3)** Preparation of a major research paper for M.M.A. students under the guidance of a graduate faculty member. *Pre: graduate standing in the M.M.A. program. S/U credit.* Staff

**591, 592 Directed Study or Research (I and II, 3)** Areas of special research interest of graduate students. (Lec. 3) *Pre: permission of chairperson.* Staff

**595 Problems of Modernization in Developing Nations**  
See Resource Economics 595.

**599 Master's Thesis Research (I and II)** Number of credits is determined each semester in consultation with the major professor or program committee. *S/U credit.* Staff

**602 Federal Ocean Policy and Organization (II, 3)** Ocean policy development and implementation by the executive and legislative branches of government. Allocation of powers and analysis of the decision-making process for the oceans. (Lec. 3) Juda

**651, 652 Marine Affairs Seminar (I and II, 3 each)** Interdisciplinary seminar conducted by marine affairs program faculty supplemented by guest speakers from industry and government. Focuses on problems of marine resources development and management at the local, state, national, and international policy levels. (Lec. 3) Burroughs, Juda, Krausse, Marti, Nixon, and West

## Mathematics

M.S., Ph.D.  
401-792-2709

### Graduate Faculty

*Chairperson:* Professor John T. Montgomery, Ph.D., 1971, University of Wisconsin  
*Director of Graduate Studies:* Associate Professor Barbara Kaskosz, Ph.D., 1977, Polish Academy of Sciences  
Professor Raymond A. Beauregard, Ph.D., 1968, University of New Hampshire  
Professor Dilip K. Datta, Ph.D., 1963, Delhi University  
Professor Rodney D. Driver, Ph.D., 1960, University of Minnesota  
Professor John B. Fraleigh, M.A., 1956, Princeton University  
Professor Edward A. Grove, Ph.D., 1969, Brown University  
Professor Gerasimos Ladas, Ph.D., 1968, New York University  
Professor James T. Lewis, Ph.D., 1969, Brown University  
Professor Pan-Tai Liu, Ph.D., 1968, State University of New York, Stony Brook

Professor Lewis I. Pakula, Ph.D., 1972, Massachusetts Institute of Technology  
 Professor Oved Shisha, Ph.D., 1958, Hebrew University  
 Professor Robert C. Sine, Ph.D., 1962, University of Illinois  
 Professor E. Ramnath Suryanarayan, Ph.D., 1961, University of Michigan  
 Professor Ghasi Ram Verma, Ph.D., 1957, Rajasthan University  
 Associate Professor Dean Clark, Ph.D., 1978, Brown University  
 Associate Professor Norman J. Finizio, Ph.D., 1972, Courant Institute of Mathematical Sciences, New York University  
 Assistant Professor Nancy Eaton, Ph.D., 1992, Emory University  
 Assistant Professor Orlando Merino, Ph.D., 1988, University of California, San Diego  
 Assistant Professor Catherine Roberts, Ph.D., 1992, Northwestern University  
 Adjunct Assistant Professor David H. Wood, Ph.D., 1972, University of Rhode Island  
 Professor Emeritus Emilio O. Roxin, Ph.D., 1959, University of Buenos Aires  
 Professor Emeritus Sol Schwartzman, Ph.D., 1953, Yale University

### Specializations

Ordinary, functional, and stochastic differential equations, partial differential equations, abstract differential equations, difference equations, functional analysis, approximation theory, probability, fluid mechanics, control theory, and differential games.

### Master of Science

*Admission requirements:* bachelor's degree with strong undergraduate background in mathematics. Applicants with deficiencies in mathematics may be accepted subject to taking certain undergraduate courses in addition to the graduate program requirements.

*Program requirements:* 30 credits (or 24 plus thesis), including at least 18 credits in mathematics of which at least 12 must be at the 500 level or above. A course requiring a substantial paper involving significant independent study and a written comprehensive examination are required for the nonthesis option. MTH 435 and 513 must be completed with a grade of A or B. Recommended courses include MTH 515, 525, 535, 536, and 562.

### Doctor of Philosophy

*Admission requirements:* same as for master's program.

*Program requirements:* MTH 513, 515, 525, 535, 536, and 562, plus specialized courses and electives. Reading ability (in candidate's specialty and with a dictionary) in one language chosen from French, German, or Russian. An oral qualifying examination is required of all candidates.

Please also see the listing under Applied Mathematical Sciences on page 28.

### General Information

Programs of study can be designed for individuals who are employed on a full-time basis. However, all Ph.D. candidates must register full time for two consecutive semesters prior to taking the doctoral comprehensive examination.

### MTH Courses Mathematics

- 418 Matrix Analysis (II, 3)  
 420 Topics in Foundations (I, 3)  
 425 Topology (I, 3)  
 435, 436 Introduction to Mathematical Analysis I, II (I and II, 3 each)  
 437, 438 Advanced Calculus and Applications (I and II, 3 each)  
 441 Introduction to Partial Differential Equations (I, 3)  
 444 Ordinary Differential Equations (II, 3)  
 447 (or CSC 447) Discrete Mathematical Structures (I, 3)  
 451 Introduction to Probability and Statistics (I, 3)  
 452 Mathematical Statistics (II, 3)  
 456 Introduction to Random Processes (II, 3)  
 461 Methods of Applied Mathematics (I, 3)  
 462 Functions of a Complex Variable (II, 3)  
 464 Advanced Engineering Mathematics (II, 3)  
 471 Introduction to Numerical Analysis I (I and II, 3)  
 472 Introduction to Numerical Analysis II (II, 3)  
 492 Special Problems (I and II, 1–3)

513 Linear Algebra (I, 3) Linear spaces and transformations, linear functionals, adjoints, projections, diagonalization, Jordan form of matrices, inner products; positive, normal, self-adjoint, and unitary operators; spectral theorem, bilinear and quadratic forms. (Lec. 3) Staff

515, 516 Algebra I, II (I and II, 3 each) Groups, rings, modules, commutative algebra. (Lec. 3) Pre: 316. In alternate years. Next offered 1994–95. Staff

525 Topology (II, 3) Topological spaces, separation properties, connectedness, compactness, uniformities. Function spaces, spaces of continuous functions, and complete spaces. (Lec. 3) Pre: 425 or equivalent. In alternate years. Next offered spring 1995. Staff

535, 536 Measure Theory and Integration (I and II, 3 each) Elements of topology and linear analysis. Lebesgue measure and integration in  $\mathbb{R}$ , in  $\mathbb{R}^n$ , and in abstract spaces. Convergence theorems. Bounded variation, absolute continuity, and differentiation. Lebesgue-Stieltjes integral. Fubini and Tonelli theorems. The classical Banach spaces. (Lec. 3) Pre: 435. Staff

545, 546 Ordinary Differential Equations I, II (I and II, 3 each) Existence and uniqueness theorems. Continuous dependence on parameters and initial conditions. Singularities of the first and second kinds, self-adjoint eigenvalue problems on a finite interval. Oscillation and comparison theorems. Introduction to delay and difference equations. Elements of stability theory of Lyapunov's second method. (Lec. 3) Pre: 435. In alternate years. Next offered 1993–94. Staff

547 (or CSC 547) Combinatorics and Graph Theory (I, 3) Enumeration: generating functions, recurrence relations, classical counting numbers, inclusion-exclusion, combinatorial designs. Graphs and their applications: Euler tours, Hamilton cycles, matchings and coverings in bipartite graphs, the four-color problem. Pre: 215 or equivalent. In alternate years. Next offered fall 1994. Staff

548 Topics in Combinatorics (II, 3) Topics such as Ramsey theory, Polya theory, network flows and the max-flow-min-cut variations, applications in operations research; finite fields and algebraic methods; block designs, coding theory, other topics. Pre: 547 or permission of instructor. In alternate years. Next offered spring 1994. Staff

550 Probability and Stochastic Processes (II, 3) Review of probability theory. Generating functions, renewal theory, Markov chains and processes, Brownian motions, stationary processes. (Lec. 3) Pre: 437 or 435 and 451, or permission of instructor. In alternate years. Next offered spring 1994. Staff

551 Mathematical Statistics (II, 3) Theory of estimation and hypothesis testing. Large sample methods. Regression and analysis of variance. (Lec. 3) Pre: 437 or 435 and 451, or permission of instructor. In alternate years. Next offered spring 1995. Staff

561 Advanced Applied Mathematics (II, 3) Linear spaces, theory of operators. Green's functions, eigenvalue problems of ordinary differential equations. Application to partial differential equations. (Lec. 3) Pre: 461. Staff

562 Complex Function Theory (I, 3) Rigorous development of theory of functions. Topology of plane, complex integration, singularities, conformal mapping. Pre: 435 and 436 or 437 and 438 and permission of instructor. In alternate years. Next offered fall 1994. Staff

572 Numerical Analysis (II, 3) Further numerical methods of solution of simultaneous equations, partial differential equations, integral equations. Error analysis. (Lec. 3) Pre: 472. Staff

575 Approximation Theory and Applications to Signal Processing  
 See Electrical Engineering 575.

591, 592 Special Problems (I and II, 1–3 each) Advanced work under the supervision of a member of the department arranged to suit the individual requirements of the student. Pre: permission of chairperson. Staff

**599 Master's Thesis Research (I and II)**  
Number of credits is determined each semester in consultation with the major professor or program committee. *S/U credit.*

**629, 630 Functional Analysis I, II (I and II, 3 each)** Banach and Hilbert spaces, basic theory. Bounded linear operators, spectral theory. Applications to analysis. Application to a special topic such as differential operators, semigroups and abstract differential equations, theory of distributions, or ergodic theory. (Lec. 3) *Pre: 536 or permission of instructor. Staff*

**641 Partial Differential Equations I (I, 3)**  
First order systems. The Cauchy-Kowalewsky theorem. The Cauchy problem. Classification of partial differential equations. Hyperbolic equations. Mainly the theory of the subject. Students interested in techniques for the solution of standard equations should take 441. (Lec. 3) *Pre: 215, 435, and 462. In alternate years. Next offered fall 1994. Staff*

**642 Partial Differential Equations II (II, 3)**  
Elements of potential theory. Elliptic equations. Green's function. Parabolic equations. Introduction to the theory of distributions. (Lec. 3) *Pre: 641. In alternate years. Next offered spring 1995. Staff*

**691, 692 Special Topics I, II (I and II, 3 each)** Advanced topics of current research in mathematics will be presented with a view to expose the students to the frontiers of the subject. (Lec. 3) *Pre: permission of chairperson. Staff*

**699 Doctoral Dissertation Research (I and II)** Number of credits is determined each semester in consultation with the major professor or program committee. *S/U credit.*

**930 Workshop in Mathematics Topics for Teachers (I and II, 0-3)** Especially designed for teachers of mathematics. Basic topics of mathematics from an advanced or pedagogical perspective. (Lec. or Lab.) *Pre: teacher certification. Not for degree credit. Staff*

## Mechanical Engineering and Applied Mechanics

M.S., Ph.D.  
401-792-2524

### Graduate Faculty

*Chairperson:* Professor Martin H. Sadd, Ph.D., 1971, Illinois Institute of Technology  
*Director of Graduate Studies:* Professor Arun Shukla, Ph.D., 1981, University of Maryland  
Professor Philip Datsis, Ph.D., 1976, Columbia University  
Professor Frank DeLuise, M.S., 1950, University of Rhode Island  
Professor Mohammad Faghri, Ph.D., 1973, Oregon State University

Professor William R. Ferrante, Ph.D., 1962, Virginia Polytechnic Institute  
Professor Hamouda Ghonem, Ph.D., 1978, McGill University  
Professor Thomas J. Kim, Ph.D., 1967, University of Illinois  
Professor Richard C. Lessmann, Ph.D., 1969, Brown University  
Professor William J. Palm, Ph.D., 1971, Northwestern University  
Professor Frank M. White, Ph.D., 1959, Georgia Institute of Technology  
Professor Mason P. Wilson, Jr., Ph.D., 1968, University of Connecticut  
Associate Professor Daniel G. Olson, Ph.D., 1987, University of Minnesota  
Assistant Professor Musa Jouaneh, Ph.D., 1989, University of California, Berkeley  
Assistant Professor David G. Taggart, Ph.D., 1989, University of Pennsylvania  
Assistant Professor Zongqin Zhang, Ph.D., 1990, Duke University  
Adjunct Professor Alexander J. Patton, Ph.D., 1972, University of Rhode Island  
Adjunct Assistant Professor Wayne Tucker, Ph.D., 1987, University of Rhode Island  
Adjunct Associate Professor Richard H. Messier, Ph.D., 1975, Brown University  
Adjunct Assistant Professor Richard Hubbell, Ph.D., 1989, University of Rhode Island  
Professor Emeritus Charles D. Nash, Jr., Ph.D., 1959, Ohio State University

### Specializations

*Fluid mechanics:* boundary layer theory, separated flows, turbulence, particle flow interactions, dispersions, geophysical flows, flow measurement, computational methods.

*Robotics and design:* robotics, expert systems, kinematics, design optimization, lubrication theory, dynamic face seals, reliability analysis and prediction, computer-aided design, manufacturing.

*Solid mechanics:* elasticity, plasticity, continuum mechanics, fracture mechanics, fatigue, photomechanics, wave propagation and dynamic geomechanics, computational methods including finite element and boundary element methods, composite and ceramic material behavior, micromechanics, nonlinear mechanics, mechanics of waterjet processing, fiber optic sensors.

*Systems and control:* robotics, mathematical modeling of control systems, stability, nonlinear systems, microprocessor and digital control, advanced dynamics, lumped and distributed parameter vibration theory.

*Thermal science:* phase change problems, convection heat transfer, direct contact heat transfer, direct energy conversion, solar energy developments, new engine developments, thermal pollution, solar collector systems, computational heat transfer.

### Master of Science

*Admission requirements:* GRE (required of foreign applicants only), B.S. degree in mechanical engineering, applied mechanics,

aerospace engineering, or in a related field such as engineering science, civil engineering, applied mathematics, applied physics. Students admitted to the program will be expected to have the equivalent of MCE 372 and 373. Students without this background may be required to make up this deficiency with no program credits.

*Program requirements:* thesis option—30 credits exclusive of seminar; thesis (required of all full-time students); one course outside the area of specialization; MCE 501, 502, graduate seminar (required of all on-campus students). Nonthesis option for part-time students—permission of chairperson; 33 credits exclusive of seminar, including one course outside specialization; one course requiring a substantial paper involving significant independent study; and a comprehensive examination.

*Financial aid:* a number of graduate and research assistantships are available for qualified M.S. students.

### Doctor of Philosophy

*Admission requirements:* GRE (required of foreign applicants only); master's degree. Exceptional students with a bachelor's degree and superior master's candidates who have passed the Ph.D. qualifying examination also will be considered.

*Program requirements:* Ph.D. qualifying examination; students admitted with only a bachelor's degree are required to take this examination after one year of full-time study. Completion of a minimum of 24 credits of course work beyond the master's degree, exclusive of seminar (48 credits of course work after bachelor's degree); MCE 501, 502, graduate seminar (required of all on-campus students). Comprehensive examination and dissertation.

*Financial aid:* a number of graduate and research assistantships are available for qualified Ph.D. students. Temporary instructorships may be available for highly qualified Ph.D. students.

### General Information

Programs of study can be designed for individuals who are employed on a full-time basis.

### MCE Courses Mechanical Engineering and Applied Mechanics

- 423 Design of Machine Elements (I, 3)
- 425 Lubrication and Bearings (I, 3)
- 426 Advanced Mechanics of Materials (I, 3)
- 429 Comprehensive Design (II, 3)
- 430 Computer-Aided Design (II, 3)
- 431 Computer Control of Mechanical Systems (I, 3)
- 434 Thermal Environmental Engineering (II, 3)
- 437 Turbomachinery Design (I, 3)
- 438 Internal Combustion Engines (I, 3)

**439 Applied Energy Conversion (II, 3)**  
**440 Mechanics of Composite Materials (I or II, 3)**

**446 (or IME 446) Metal Deformation Processes (I, 3)**

**448 Heat and Mass Transfer (I, 3)**

**449 (or IME 449) Product Design for Manufacture (II, 3)**

**455 Advanced Fluid Mechanics (I, 3)**

**457 Fluidics (II, 3)**

**464 Vibrations (II, 3)**

**465 Experimental Mechanics (I, 3)**

**466 Introduction to Finite Element Methods (II, 3)**

**491, 492 Special Problems (I and II, 1–6 each)**

**501, 502 Graduate Seminar (I and II, 1 each)** Discussions, presentation of papers based on research, or detailed literature surveys. Attendance is required of all students in graduate residence. (Lec. 1) *S/U credit*. Staff

**503 Linear Control Systems**  
 See Electrical Engineering 503.

**504 Optimal Control Theory**  
 See Electrical Engineering 504.

**505 Optimization in Mechanical Engineering Design (I or II, 3)** Unified presentation of optimization techniques pertinent to mechanical engineering, emphasizing similarity of design processes for thermal systems, mechanics, and control. Finite and infinite dimensional methods. (Lec. 3) *Pre: 366 and 423 or equivalent*. Palm and Datseris

**506 Expert Systems for Mechanical Design and Manufacturing (I, 3)** Expert systems structure; knowledge bases, inference engines, and artificial intelligence languages. Applications to mechanical design and manufacturing problems. Graph theory and expert systems for mechanism design; features for design and manufacturing. (Lec. 3) *Pre: 430 or equivalent*. Datseris or Olson

**521 Reliability Analysis and Prediction (II, 3)** Statistical analysis of failure of complex engineering systems, design factors contributing to functional system survival, failure, distribution functions, redundancy, confidence, reliability testing. (Lec. 3) *Pre: MTH 451 or equivalent, MCE 423 or permission of instructor*. Staff

**523 Advanced Kinematics I (II, 3)** Analytical kinematic and dynamic analysis of planar mechanisms, graph theory, topological synthesis, topological analysis, Burmester theory, mechanism design software. (Lec. 3) *Pre: 323 or equivalent*. Datseris or Olson

**541 Advanced Thermodynamics I (I or II, 3)** Advanced study of classical thermodynamics with emphasis on basic concepts, laws, and thermodynamic relationships. Selected topics of current interest including areas of irreversible thermodynamics, statistical mechanics, and the thermodynamics of solids. (Lec. 3) *Pre: 341, 342, or permission of instructor*. Wilson, Zhang, and Ibrahim

**545 Heat Transfer (I, 3)** Conduction in two and three dimensions and conducting systems with radiation and fluid motion. Solutions obtained by mathematics, computer-numerical methods, and analog devices. (Lec. 3) *Pre: 448*. Faghri, Wilson, and Zhang

**546 Convection Heat Transfer (II, 3)** Relationship between heat transfer and fluid flow with emphasis on the solution of governing equations by exact methods, integral methods, and similarity techniques. (Lec. 3) *Pre: 448*. White, Faghri, and Zhang

**549 Advanced Product Design for Manufacture**

See Industrial and Manufacturing Engineering 549.

**550 Theory of Continuous Media (I, 3)** Basic course for first-year graduate students which develops and unifies the laws of mechanics as applied to the behavior of continua. Application to solids and fluids. (Lec. 3) *Pre: CVE 220, MCE 354, 372, or permission of instructor*. Sadd

**551 Fluid Mechanics I (I, 3)** Basic treatment of real fluid flows using the continuum mechanics approach. Exact solutions of the governing equations. Laminar shear flows and boundary layer theory, turbulent transition. (Lec. 3) *Pre: 354 or equivalent*. Lessmann and White

**561 Computational Methods in Solid Mechanics (I or II, 3)** Finite and boundary element methods based on variational and weighted residual concepts; practical implementation to field problems in elasticity, plasticity, and heat conduction. (Lec. 3) *Pre: 373 and one graduate course in elasticity or heat conduction*. Kim, Sadd, and Taggart

**562 Computational Methods in Fluid Flow and Heat Transfer (I or II, 3)** Computational techniques and applications for practical problems concerning multidimensional fluid flow, heat and mass transfer, and chemical reactions. (Lec. 3) *Pre: undergraduate work in fluid mechanics and heat transfer or permission of instructor*. Faghri

**563 Advanced Dynamics (I and II, 3)** Dynamics of a system of particles, Lagrange's equations from an advanced point of view. Variational methods, non-conservative and nonholonomic systems; matrix-tensor specifications of rigid body motions, normal coordinates. Hamilton's equation of motion, canonical transformation, Hamilton-Jacobi theory. (Lec. 3) *Pre: 366 and 372 or equivalent*. Datseris

**564 Advanced Vibrations (I, 3)** Theory of vibration of systems with concentrated masses and stiffness; systems with one degree of freedom, vibration isolation systems with many degrees of freedom, matrix methods, dynamic vibration absorbers, torsional vibration, approximate numerical methods. Experimental methods and design procedures. (Lec. 3) *Pre: 464*. Palm

**565 Wave Motion and Vibration of Continuous Media (II, 3)** Wave motion and vibrations of strings, rods, beams, plates, and membranes; dynamic elasticity theory; Rayleigh surface waves; solutions using separation of variables and integral transforms. (Lec. 3) *Pre: 373, 464, or equivalent*. Sadd and Shukla

**566 The Mechanics of Robot Manipulators (I or II, 3)** Detailed analysis of the kinematics, dynamics, and control of industrial-type robot manipulator systems (Lec. 3) *Pre: 323, 366, or permission of instructor*. Palm and Jouaneh

**568 Theory of Plates**  
 See Civil Engineering 568.

**571 Theory of Elasticity I (I, 3)** Development of the basic field equations; generalized Hooke's law; general concepts of stress and strain; plane problems; stress functions; Saint Venant torsion and flexure; introduction to three-dimensional problems. (Lec. 3) *Pre: CVE 220 or equivalent*. Sadd, Ghonem, Shukla, and Taggart

**576 Fracture Mechanics (II, 3)** Fundamentals of linear elastic fracture mechanics, stress analysis viewpoint, energy viewpoint, two-dimensional and three-dimensional problems, elastic-plastic considerations, and crack extension behaviors. (Lec. 3) *Pre: 426 or permission of instructor*. Shukla and Ghonem

**599 Master's Thesis Research (I and II)** Number of credits is determined each semester in consultation with the major professor or program committee. *S/U credit*.

**623 Advanced Kinematics II (I, 3)** Planar, curvature theory, spatial kinematics: homogeneous transformations, screw theory, quaternions, dual numbers, angles, and vectors, applications to robot and machine tool calibration. (Lec. 3) *Pre: MCE 523 or permission of instructor*. Datseris and Olson

**641 Advanced Thermodynamics II (I or II, 3)** Continuation of 541. (Lec. 3) *Pre: 541 or permission of instructor*. Wilson and Ibrahim

**646 (or CHE 646) Radiation Heat Transfer (I or II, 3)** Radiant exchange between surfaces. Radiative properties of surfaces. Exchange among nonideal surfaces. Gas-radiative exchange. Radiative exchange with volume emitters. Furnace design applications. (Lec. 3) *Pre: 545 or CHE 644 or permission of instructor*. Staff

**650 (or CHE 650) Advanced Topics in Heat Transfer (I or II, 3)** Advanced topics in heat transfer which are of current research interest. Topics may involve all modes of heat transfer and could include phase change and mass transfer. (Lec. 3) *Pre: 545, 546, or permission of instructor*. Staff

**652 Experimental Methods in Fluid Mechanics (II, 3)** An overview of measurement techniques and instrumentation used in the current practice of experimental fluid mechanics. Course emphasizes hot wire, hot

film, and laser anemometry. Provides practical laboratory experience. (Lec. 2, Lab. 3) *Pre: 551 or permission of instructor.* Lessmann

**653 Fluid Mechanics II (II, 3)** Continuation of 551, including turbulent modeling, turbulent shear flows and boundary layers, incompressible irrotational flows, and selected topics such as an introduction to non-Newtonian fluid behavior, geophysical flows, or numerical methods. (Lec. 3) *Pre: 551.* Lessmann and White

**654 Fluid Mechanics III (I, 3)** Two- and three-dimensional compressible flows, numerical methods for the solution of compressible and incompressible parabolic and elliptic problems. Other advanced topics of current interest. (Lec. 3) *Pre: 551.* Lessmann and White

**666 Nonlinear Mechanics (I and II, 3)** Dynamics of nonlinear systems, free and forced oscillations; graphical methods, integral curves, singular points, limit cycles and stability. Van der Pol equation, perturbation methods, approximate methods, application to ecological systems. (Lec. 3) *Pre: 564.* Staff

**668 (or CVE 668) Theory of Shells (I or II, 3)** Development of basic shell equations. Classical solution examples for membrane shells and shells of revolution with bending. Additional topics selected from variational methods, finite element techniques, reinforced and composite shells. (Lec. 3) *Pre: 568 or permission of instructor.* Sadd and Karamanlidis

**671 Theory of Elasticity II (II, 3)** Continuation of 571, including advanced topics selected from: complex variable methods; displacement potentials and stress functions for three-dimensional problems; thermoelasticity; variational, approximate, and numerical methods; anisotropic solutions. (Lec. 3) *Pre: 571.* Sadd, Taggart, and Kim

**678 Micromechanics (II, 3)** Mechanics of material behavior from the microstructural viewpoint; mathematical modeling of inclusions, inhomogeneities, dislocations, granular and porous structures; constitutive equation development. Applications to metals, composites, ceramics, and other materials with microstructure. (Lec. 3) *Pre: 571, materials background of CHE 333 or higher.* Ghonem and Taggart

**679 Theory of Plasticity (II, 3)** Formulation and solution of inelastic material behavior, physical phenomena of yielding plastic flow, plastic stress-strain laws, yield criteria, plane problems, torsion, slip lines, limit analysis, creep. (Lec. 3) *Pre: 571 or permission of instructor.* Ghonem and Sadd

**680 Advanced Topics in Solid Mechanics (I or II, 3)** Advanced studies in the mechanics of solids with specific topics determined by current department interests. Designed for students with at least one year of previous graduate studies. (Lec. 3) *Pre: permission of instructor.* May not be repeated. Staff

**691, 692 Special Problems (I and II, 1–6 each)** Advanced work under the supervision of a staff member arranged to suit the individual requirements of the student. (Lec. or Lab. according to nature of problem) *Pre: permission of chairperson.* May be repeated for a maximum of 12 credits. Staff

**699 Doctoral Dissertation Research (I and II)** Number of credits is determined each semester in consultation with the major professor or program committee. *S/U credit.*

## Medicinal Chemistry

M.S., Ph.D. (Pharmaceutical Sciences)  
401-792-2776

### Graduate Faculty

*Chairperson:* Professor Raymond P. Panzica, Ph.D., 1972, University of Utah  
Professor Elie Abushanab, Ph.D., 1965, University of Wisconsin  
Professor Daniel Traficante, Ph.D., 1962, Massachusetts Institute of Technology  
Assistant Professor Bongsup P. Cho, Ph.D., 1985, University of Illinois Medical Center

### Specializations

Research activities are focused on the design and synthesis of chemotherapeutic agents. The areas of cancer and viral chemotherapy receive the greatest attention from our faculty. Research projects include the rational development of new compounds by synthetic or microbial methods, the chemical modification of clinical agents to facilitate drug delivery to targeted sites, and the synthesis of enzyme inhibitors. Other projects focus on the synthesis of agents to combat tropical and cardiovascular diseases, and on mechanisms of chemical carcinogenesis.

### Master of Science

*Admission requirements:* GRE (for graduates of non-U.S. universities only) and bachelor's degree in pharmacy, chemistry, biochemistry, or allied sciences.

*Program requirements:* thesis; A.C.S. placement examination (organic) to determine specific program requirement; CHM 431, 432, or BCP 435 or equivalent; CHM 425, 427, and 521 or 522; MCH 443, 444, or equivalent; MCH 548 or equivalent, 621, 622; written master's examination. All students must register for and attend a seminar each semester while in graduate residence. Each student will present one seminar per semester unless otherwise indicated by the majority of the departmental faculty.

## Doctor of Philosophy (Pharmaceutical Sciences)

*Admission requirements:* GRE and master's degree in pharmacy, chemistry, biochemistry, or allied sciences, or bachelor's degree in one of these with evidence of superior ability.

*Program requirements:* dissertation; A.C.S. placement examination (organic) to determine specific program requirement; same as for master's degree plus CHM 521 and 522; also MCH 501, 533, and 549 recommended; primary emphasis in organic, medicinal chemistry, and pharmaceutical analysis. Comprehensive examination.

Qualifying examination is required for candidates accepted without M.S. degree.

## MCH Courses

### Medicinal Chemistry

**443, 444 Organic Medicinal Chemistry (I and II, 3 each)**

**497, 498 Special Problems (I and II, 1–5 each)**

**526 Lipid Chemistry**

See Food Science and Technology 526.

**548 (or PCG 548) Physical Methods of Identification (II, 3)** Utilization of physical methods (primarily spectroscopic) in the structure elucidation of complex organic molecules. Emphasis on interpretation of ultraviolet, infrared, nuclear magnetic resonance, mass, and optical rotatory dispersion spectra. (Lec. 3) *Pre: CHM 425 and/or permission of instructor.* Staff

**549 Synthesis (I and II, 3)** Theoretical and applied aspects in synthesis of selected organic compounds of medicinal significance. (Lab. 9) *Pre: permission of instructor.* Staff

**599 Master's Thesis Research (I and II)** Number of credits is determined each semester in consultation with the major professor or program committee. *S/U credit.*

**621, 622 Seminar (I and II, 1 each)** Seminar discussions including student presentations of papers on selected topics in medicinal chemistry. (Lec. 1) *May be repeated for a maximum of 3 credits.* *S/U credit.* Staff

**643 Advanced Organic Medicinal Chemistry (II, 3)** Synthesis, modes of action, and effects on pharmacological activity. Analgesics, cholinergics, folic acid antagonists, diuretics, and sulfonamides are included. (Lec. 3) *Pre: CHM 522 and permission of instructor.* In alternate years. Next offered 1993–94. Staff

**646 Alkaloids (I, 3)** Advanced course dealing with proof of structure, synthesis, chemical properties, and biological activity of various alkaloids. (Lec. 3) *Pre: permission of instructor.* Abushanab

**697, 698 Research in Medicinal Chemistry (I and II, 1–3 each)** Literature survey, laboratory work, and a detailed research report on one or more assigned topics in medicinal chemistry. (Lab. 3–9) *Pre: permission of instructor.* Staff

**699 Doctoral Dissertation Research (I and II)** Number of credits is determined each semester in consultation with the major professor or program committee. *S/U credit.*

## Microbiology

M.S., Ph.D. (Biological Sciences)  
401-792-2205

### Graduate Faculty

#### *Chairperson and Director of Graduate Studies:*

- Professor David C. Laux, Ph.D., 1971,  
University of Arizona  
Professor Victor J. Cabelli, Ph.D., 1951,  
University of California, Los Angeles  
Professor Paul S. Cohen, Ph.D., 1964,  
Boston University  
Professor Harold W. Fisher, Ph.D., 1959,  
University of Colorado  
Professor Linda A. Hufnagel, Ph.D., 1967,  
University of Pennsylvania  
Professor Richard W. Traxler, Ph.D., 1958,  
University of Texas  
Professor Norris P. Wood, Ph.D., 1955,  
University of Pennsylvania  
Associate Professor David R. Nelson, Ph.D.,  
1979, University of California, Los Angeles  
Associate Professor Jay F. Sperry, Ph.D.,  
1974, University of Kansas  
Assistant Professor Joanna F. Norris, Ph.D.,  
1982, Michigan State University  
Adjunct Professor William D. Watkins,  
Ph.D., 1979, University of Rhode Island  
Adjunct Assistant Professor Shashikant R.  
Mehta, Ph.D., 1984, University of Texas,  
Houston  
Adjunct Assistant Professor Scott R. Rippey,  
Ph.D., 1979, University of Rhode Island

### Specializations

*Medical microbiology:* pathogenesis, immunology, mycology, virology.

*Microbial genetics, physiology, molecular microbiology:* genetic and molecular relation of cellular morphogenesis and development, bacterial colonization of the mammalian intestine, messenger RNA metabolism in procaryotes and eucaryotes, virus multiplication, control of transport and metabolism, mechanisms of survival, membrane structure.

*Cell biology, cellular development, ultrastructure:* ciliogenesis in protozoa, electron microscopy, ultrastructure of electrically conducting systems, cell culture, cellular immunity.

*Microbial ecology, industrial microbiology, pollution:* marine and freshwater microbial ecology, biodeterioration, sanitary bacteriology, coliform ecology.

### Master of Science

*Admission requirements:* GRE and two semesters each of biology (zoology, botany), general and organic chemistry, mathematics, calculus, and physics; a semester each of microbiology, genetics, quantitative analysis, biochemistry, and statistics. Applicants with deficiencies in these background courses may be required to complete appropriate course work without graduate credit.

*Program requirements:* thesis; BCP 581; MIC 413, 414, 415, 416, 599, 695, and 696; major portion of courses in microbiology, including one from an area other than bacteriology (virology, mycology, phycology, cell biology, protozoology); written comprehensive examination.

### Doctor of Philosophy (Biological Sciences)

*Admission requirements:* same as for master's degree. A course in physical chemistry is also recommended.

*Program requirements:* same as for master's degree plus BCP 582; MIC 533, 552, and dissertation. A course in microbial physiology (MIC 641, BOT 534, OCG 663 or equivalent). Of the credits earned beyond the master's degree, 18 should be in course work. Qualifying examination is required for students admitted without a master's degree. Prior to the last semester, the candidate must pass a written and oral comprehensive examination in the major areas of microbiology. Dissertation.

### MIC Courses Microbiology

- 401 (or BCP 401) Quantitative Cell Culture (I, 3)**  
**403 (or BCP 403) Introduction to Electron Microscopy (I, 2)**  
**405 (or BCP 405) Electron Microscopy Laboratory (I, 2)**  
**412 Food Microbiology (II, 3)**  
**413 Advanced Microbiology Lecture I (I, 3)**  
**414 Advanced Microbiology Lecture II (II, 3)**  
**415 Advanced Microbiology Laboratory I (I, 2)**  
**416 Advanced Microbiology Laboratory II (II, 2)**  
**421 (or BCP 421) Cell Biology and Cancer (I, 3)**  
**422 (or FSN 422) Industrial Microbiology (II, 3)**  
**432 Pathogenic Bacteriology (II, 3)**  
**451 (or BOT 451) Laboratory in Cell Biology (II, 1)**  
**453 (or BOT 453) Cell Biology (II, 3)**  
**483 (or MTC 483) Introductory Diagnostic Microbiology (I, 3)**  
**495, 496 Seminar in Microbiology (I and II, 1 each)**

**501 Advanced Clinical Microbiology**  
See Medical Technology 501.

**502 Techniques in Microbial and Molecular Genetics (II, 2)** Techniques for the study of molecular genetics in bacteria and bacteriophages including mutant isolation, phage growth, transformation, transduction, conjugation, DNA isolation and analysis, and gene cloning. (*Lab. 6*) *Pre:* 413 and 415 or BOT 437 or BOT 454 or BOT 522 or permission of instructor. Nelson or Cohen

**503 (or BCP 503) Electron Microscopy (I, 2)** Biological specimen preparation techniques for transmission and scanning electron microscopy. Includes thin sectioning, negative staining, shadow-casting, freeze-etching, cytochemistry, principles of electron microscope operation. Final written and oral reports. (*Lec. 2*) *Pre:* graduate standing or permission of instructor. Not open to students with credit in 403. Hufnagel

**505 (or BCP 505) Laboratory in Electron Microscopy (I, 3)** Introduction to biological sample preparation for transmission and scanning electron microscopy. Tissue preparation, ultramicrotomy, operation of the electron microscope, darkroom procedures, particulate and molecular sample preparation, critical point drying, sputtercoating. Not open to students who have taken 405. (*Lab. 6*) *Pre:* graduate standing or permission of instructor. Hufnagel

**513 Advanced Clinical Immunology**  
See Medical Technology 513.

**514 The Electron Microscope in Molecular and Cellular Biology (II, 2)** Use of the electron microscope to analyze structure and function of biological molecules. Applications in food science, pathology, pharmacology, ecology, gene engineering, and basic research. (*Lec. 2*) *Pre:* BCP 311 and BOT 352 or permission of instructor. In alternate years. Next offered spring 1994. Hufnagel

**521 (or BOT 521 or ZOO 521) Recent Advances in Cell Biology (I, 2)** Reading of current papers in the area of cell biology and preparation of written and oral reports. Emphasis on animal cells. (*Lec. 2*) *Pre:* at least one of the following courses or an equivalent course emphasizing cell structure and function—ZOO 327, 421, BOT 432, 445, 453, and MIC 408; graduate standing or permission of instructor. May be repeated for a maximum of 4 credits. Hufnagel

**523 (or FSN 523 or NRS 523) Water Pollution Microbiology (I, 3)** The microbiological aspects of water pollution, including the potential for infectious diseases, pollution effects on microbial ecosystems, and the microbial degradation of pollutants. (*Lec. 3*) *Pre:* 201 or 211, BCP 311, or permission of instructor. Credit or concurrent enrollment in 525. Cabelli and Traxler

**525 (or FSN 525) Water Pollution Microbiology Laboratory (I, 1)** Experimental method for pollution analysis, microbial indicator assay methods, microbial assays, sample collection and statistical treatment of data. (*Lab. 3*) *Pre:* concurrent enrollment in 523 or permission of instructor. Cabelli

**533 Immunology (II, 3)** Introduction to the cellular, molecular, and genetic basis of the immune system, and the role of the immune system in immunity to infection, tumor and transplantation immunobiology, and immunopathology. (*Lec. 3*) *Pre:* 201 or 211. Laux

**534 Animal Virology**

See Aquacultural Science and Pathology 534.

**536 Virology Laboratory**

See Aquacultural Science and Pathology 536.

**538 Epidemiology of Viral and Rickettsial Diseases**

See Aquacultural Science and Pathology 538.

**541 Advanced Clinical Microbiology II**

See Medical Technology 541.

**552 Microbial Genetics (II, 3)** Recent research on the mechanism of mutation, genetic recombination, the genetic code, transposons, regulations, genetic engineering and regulation of DNA, RNA, and protein synthesis in microbial systems. (*Lec. 3*) *Pre:* 201, BOT 352, and BCP 311. Cohen

**561 Recent Advances in Molecular Cloning (I or II, 1)** Reports of readings concerning the latest developments in techniques of molecular cloning and their applications in the study of various biological systems. (*Lec. 1*) *Pre:* 552 or permission of instructor. May be repeated. Nelson

**576 Marine Microbiology**

See Oceanography 576.

**593, 594 The Literature of Bacteriology (I and II, 1 each)** Thorough study of original literature of some phase of bacteriology. Written abstracts or papers on assigned topics are discussed in weekly conferences with instructor. (*Lec. 1-2*) Staff

**599 Master's Thesis Research (I and II)** Number of credits is determined each semester in consultation with the major professor or program committee. *S/U credit.*

**622 (or BCP 622) Advanced Electron Microscopy (II, 2)** The physical functioning of electron microscopes; high resolution microscopy of macromolecules; newly available EM histochemical procedures; and computer processing of electron images. (*Lec. 2*) *Pre:* 403, 405, or permission of chairperson. Hufnagel

**624 (or BCP 624) Advanced Electron Microscopy Laboratory (II, 2)** Cleaning and aligning the electron microscope; development of independent project utilizing advanced techniques, and formal presentation of results of individual projects to the class. (*Lab. 6*) *Pre:* credit or concurrent enrollment in 622 or permission of chairperson. Hufnagel

**641 Physiology of Bacteria (II, 3)** Bacterial structure and function, including growth, nutrition, environmental factors, metabolism, biosynthesis, and energy-yielding reactions. (*Lec. 3*) *Pre:* 413 and 415. In alternate years. Next offered 1993-94. Wood

**654 Advances in Immunology (II, 2)** Reports on assigned readings concerning latest developments in the field of cellular and humoral immunity presented and discussed by students. Research paper and critical review of a scientific paper required. (*Lec. 2*) *Pre:* 533, BCP 311, or permission of instructor. May be repeated for a maximum of 4 credits. In alternate years. Next offered 1993-94. Laux

**656 Mechanisms of Bacterial Pathogenesis (I, 3)** Study of recent research on the molecular mechanisms of pathogenesis. Students expected to participate in roundtable discussions of recent pertinent literature. (*Lec. 3*) *Pre:* 432, 552, and BCP 311. In alternate years. Next offered 1993-94. Staff

**691, 692 Special Problems in Microbiology (I and II, 3 each)** Assigned research on an advanced level. Student required to outline problem, conduct the necessary literature and experimental work, and present observations and conclusions in a report. (*Lab. 6*) *Pre:* graduate standing. Staff

**695, 696 Graduate Research Seminar (I and II, 1 each)** Reports of research in progress or completed. (*Lec. 1*) *Required of all graduate students in microbiology. S/U credit.* Staff

**699 Doctoral Dissertation Research (I and II)** Number of credits is determined each semester in consultation with the major professor or program committee. *S/U credit.*

**930 Workshop in Microbiology Topics for Teachers (I and II, 0-3 each)** Especially designed for teachers of biology. Basic topics of microbiology from an advanced or pedagogical perspective. (*Lec. or Lab.*) Staff

*Note: For Virology, see Aquacultural Science and Pathology and Plant Sciences. For Mycology, see Botany.*

## Music

M.M.  
401-792-2431

### Graduate Faculty

*Chairperson:* Professor Ronald T. Lee, Ph.D., 1970, University of Michigan

*Coordinator of Graduate Studies:* Professor Gene J. Pollart, M.M., 1967, University of Colorado

Professor John D. Dempsey, M.M., 1964, Eastman School of Music, University of Rochester

Professor Henry C. Fuchs, M.Mus., 1961, University of Michigan

Professor Geoffrey D. Gibbs, D.M.A., 1974, Eastman School of Music, University of Rochester

Professor George E. Kent, M.M., 1960, New England Conservatory of Music

Professor W. Donald Rankin, D.M.A., 1970, Boston University

Associate Professor Gary Glaze, M.M., 1962, University of Michigan

Associate Professor James Ladewig, Ph.D., 1978, University of California, Berkeley

Associate Professor Carolyn Livingston, Ph.D., 1986, University of Florida

Associate Professor David Saladino, Ph.D., 1984, Florida State University

## MASTER OF MUSIC

### Specializations

Performance or music education.

### Admission Requirements

Undergraduate major, or the equivalent, in music with a quality point average of 2.50 or above. Applicants for performance as a specialization, or for the performance/essay subspecialization under music education, must pass an audition in their major performance subject on tape or, preferably, in person, before acceptance into a program. Applicants for conducting as a specialization must pass an audition in choral or instrumental conducting, on videotape or, preferably, in person.

### Program Requirements

Post-admission placement examinations in music history and theory determine whether background deficiencies must be made up with no program credit. A minimum of 30 credits is required for graduation. One-half of the program credits must be at the 500 level. (Teacher certification requires additional courses in education at the undergraduate level.)

### PERFORMANCE SPECIALIZATION

Twelve credits in MUS 561 plus MUS 548, 565, 567, and four credits distributed according to the major performance subject, as follows. *For vocalists:* two credits in 485 or 598 and music elective. *For pianists:* two credits in 590 or 598 and music elective. *For organists and guitarists:* two credits in 598 and music elective. *For other instrumentalists:* MUS 512 and ensemble elective. All performance candidates must also take a minimum of nine credits of electives from music history and theory/composition (no more than six credits in any one of these two areas), and pass a written comprehensive examination in music history, theory, and the performance major.

### MUSIC EDUCATION SPECIALIZATION

MUS 537, 540, 545, 548, and nine credits in one of the following subject areas. *Performance/essay:* MUS 551 (6 credits), 555, and 570. *Conducting:* MUS 511, 512, and 513. *Thesis:* at least six credits in MUS 599 and three elective credits. All music education candidates must also take a minimum of nine credits of electives from music history, theory/composition, and performance (no

more than six credits in any one of these three areas, and performance only if it is not already part of the specialization). Students in a thesis program must pass a written qualifying examination before thesis work is begun and defend the thesis in a final oral examination. All other music education candidates must pass a written comprehensive examination in music history, theory, and music education.

## MUS Courses Music

- 407 **The Symphony** (I, 3)  
 408 **The Opera** (II, 3)  
 418 **Composition** (II, 3)  
 419 **Composition** (I, 2)  
 420 **Eighteenth-Century Counterpoint** (II, 3)  
 422 **Advanced Orchestration** (II, 2)  
 423 **Sixteenth-Century Counterpoint** (II, 3)  
 430 **The Renaissance Period** (II, 3)  
 431 **The Baroque Era** (II, 3)  
 432 **The Classical Era** (II, 3)  
 433 **The Romantic Era** (I, 3)  
 434 **The Modern Era** (I, 3)  
 438 **Topics in Music Education** (II, 3)  
 441 **Special Projects** (I and II, 1-3)  
 442 **Directed Study in Applied Music Pedagogy** (I and II, 2)  
 451 **Performance as Minor** (I and II, 2)  
 460 **Performance as Voice Major** (I or II, 3)  
 461 **Performance as Instrument Major** (I or II, 3)  
 481, 482 **Piano Literature and Pedagogy** (I and II, 2 each)  
 483, 484 **Vocal Literature and Pedagogy** (I and II, 2 each)  
 485 **Opera Workshop** (I and II, 1)

511 **Advanced Choral Conducting** (II, 3) Critical study of choral music scores with reference to interpretation and performance. Development of technical command and expressive skills includes supervised rehearsal and conducting of university ensembles. (Lec. 3) *Pre: knowledge of conducting technique as evidenced in audition or 311.* Saladino

512 **Advanced Instrumental Conducting** (I, 3) Critical study of orchestral and chamber music scores with reference to interpretation and performance. Development of technical command and expressive skill includes supervised rehearsal and conducting of university ensembles. (Lec. 3) *Pre: knowledge of basic baton as evidenced in audition or credit in 312.* In alternate years. Next offered fall 1994. Staff

513 **Graduate Conducting Project** (I and II, 3) Preparation and conducting of a program of chamber music and/or a major ensemble with documentation. *Pre: 511, 512, and 548 and permission of chairperson.* Staff

537 **Human Response to Music** (I, 3) Study of response to acoustics, rhythm, melody, and harmony. Cognitive, psychomotor, and affective behaviors, musical preferences and abilities, learning theory, and the needs of special learners will be included. (Lec. 3) *Pre: graduate standing in music.* In alternate years. Next offered fall 1995. Pollart

538 **Topics for the Elementary School Music Teach** (SS, 3) Open-ended course examining significant materials, approaches, and current trends. Topics cover in-depth such areas as aesthetic education, process of musical development, eurhythmics, Orff, or Kodaly. May be repeated for credit with change of topic or level of training (in the case of Orff, Kodaly, or Dalcroze certification). *Pre: graduate standing in music or permission of instructor.* Livingston

540 **Foundations of Music Education** (II, 3) Examination of the broad influences upon music education. Historical, philosophical, sociological, psychological, and curricular foundations. (Lec. 3) *In alternate years.* Next offered spring 1994. Livingston and Pollart

545 **Musical Aptitude and Achievement** (I, 3) Examination of a wide variety of musical aptitudes and achievements and the ways they may be measured, tested, evaluated, and described. (Lec. 3) *Pre: graduate standing in music.* In alternate years. Next offered fall 1994. Livingston

548 **Research in Music** (II, 3) Study of research techniques as applied to the art of music. Major project procedures and data collection in the following research categories: historical, philosophical, and empirical. (Lec. 3) *Pre: graduate standing in music.* In alternate years. Next offered spring 1995. Lee

551 **Performance as Minor or Elective** (I and II, 2) Private instruction. One 60-minute lesson and scheduled practice hours each week.\* One level, one year as prescribed in performance minor syllabi. Recital performances and master classes as required by chairperson and instructor. (Studio 6) *Pre: completion of performance minor in undergraduate upper division and permission of chairperson.* May be repeated. Staff

Select area of instruction from the following, and add to course number as MUS 551B Piano:

A Voice	I Viola d'Amore	R Trombone
B Piano	J Flute	S Baritone
C Organ	K Oboe	Horn
D Harpsichord	L Clarinet	T Tuba
E Violin	M Bassoon	U Percussion
F Viola	N Saxophone	V Guitar
G Violoncello	P Trumpet	WHarp
H Bass Viol	Q French Horn	

555 **Graduate Recital for Performance Minor** (I and II, 0) Performance of advanced repertoire of various styles in a public program of at least 45 minutes performance time after faculty acceptance. *Pre: concurrent enrollment in 551 and 4 or more credits in 551.* Staff

561 **Performance Major** (I or II, 3, 4, or 6) Private instruction for graduate performance majors only. One 60-minute lesson each week.\* Recital performances and master classes as required by chairperson and instructor. See 551 for areas of instruction. (Studio 60 minutes) *Pre: audition demonstrating proficiency and comprehension equivalent to that required for the completion of the B.Mus. in performance.* May be repeated. Staff

565 **Graduate Recital for Performance Major** (I and II, 0) Performance of advanced repertoire of various styles in a public program of at least 55 minutes performing time after faculty acceptance. *Pre: concurrent enrollment in 561 and 6 or more credits in 561.* Staff

567 **Seminar in Performance and Pedagogy** (II, 2) Study of performance literature, practice, and pedagogy. Research projects and supervised teaching experience appropriate to the major performance area. (Lec. 2) *Pre: concurrent enrollment in 551 or 561.* In alternate years. Next offered spring 1995. Gibbs

570 **Graduate Project** (I and II, 3) Independent study resulting in a major essay, composition, or orchestration. *Pre: 548 and permission of chairperson.* Staff

590 **Piano Accompanying** (I and II, 1) Development of sightreading skills. Preparation and performance of accompaniments of major works. (Lec. 1) *Pre: permission of piano faculty.* May be repeated for a maximum of 3 credits. Rankin

591 **University Symphony Orchestra** (I and II, 1) (Lec. 3) *Pre: audition at graduate level of performance.* May be repeated. Staff

593 **University Chorus** (I and II, 1) (Rehearsal 3) *Pre: audition at graduate level of performance.* May be repeated. Saladino

594 **Symphonic Wind Ensemble** (I and II, 1) (Lec. 3) *Pre: audition at graduate level of performance.* Pollart

595 **Concert Choir** (I and II, 1) (Lec. 3) *Pre: audition at graduate level of performance.* Saladino

596 **Jazz and Studio Ensemble** (I and II, 1) Study and performance of jazz and studio music, with leadership roles in improvisation and sectional rehearsals and performance. Demonstration of technical and stylistic competencies for these roles in audition. (Lab. 3) Staff

597 **University Chamber Orchestra** (I and II, 1) An ensemble which offers the study and performance of standard and modern repertoire for the smaller orchestral group. Literature will be selected from the Baroque, Rococo, Classic, and contemporary periods. (Rehearsal 3) *Pre: audition at graduate level of performance.* May be repeated. Staff

\* See page 22 for the applied music fee associated with this course.

### 598 Chamber Music Ensemble (I and II, 1)

Chamber music ensembles are designated as

A Keyboard Ensemble	B String Ensemble
C Woodwind Ensemble	D Brass Ensemble
E Percussion Ensemble	G Madrigal Singers
H Guitar Ensemble	M Jazz Combo

Select appropriate letter and small ensemble from the list and add to course number, as 598B String Ensemble. Other ensemble combinations may be added. Small instrumental ensembles are normally restricted to one performer per part (*Lec. 2*) *Pre: graduate standing in music and evidence by audition of graduate-level performance. May be repeated. Staff*

### 599 Master's Thesis Research (I and II)

Number of credits is determined each semester in consultation with the major professor or program committee. *Pre: 548. May be repeated. S/U credit. Staff*

## Natural Resources

M.S., Ph.D. (Biological Sciences)  
401-792-2370

### Graduate Faculty

*Chairperson:* Professor William R. Wright, Ph.D., 1972, University of Maryland  
*Director of Graduate Studies:* Associate Professor Peter August, Ph.D., 1981, Boston University  
Professor James H. Brown, Jr., D.F., 1965, Duke University  
Professor Victor Cabelli, Ph.D., 1951, University of California, Los Angeles  
Professor Arthur J. Gold, Ph.D., 1983, Michigan State University  
Professor Francis C. Golet, Ph.D., 1973, University of Massachusetts  
Professor Thomas P. Husband, Ph.D., 1977, Michigan State University  
Professor Robert H. Miller, Ph.D., 1964, University of Minnesota  
Assistant Professor José A. Amador, Ph.D., 1990, Cornell University  
Assistant Professor William R. Eddleman, Ph.D., 1983, Oklahoma State University  
Assistant Professor Amy Gamerding, Ph.D., 1988, Cornell University  
Adjunct Professor P.A. Buckley, Ph.D., 1966, Cornell University  
Adjunct Associate Professor Peter M. Groffman, Ph.D., 1984, University of Georgia  
Adjunct Assistant Professor Vernon C. Bleich, Ph.D., 1992, University of Alaska, Fairbanks  
Adjunct Assistant Professor Josef H. Gorres, Ph.D., 1983, University of Manchester  
Adjunct Assistant Professor Mark C. Wallace, Ph.D., 1991, University of Arizona

### Specializations

Soil chemistry, soil biochemistry, soil genesis and classification, soil fertility and management, soil properties and land use, organic geochemistry, water resources management, avian and mammalian ecology, wetland ecology, forest science, wildlife habitat analysis, wildlife management.

### Master of Science

*Admission requirements:* GRE and bachelor's degree with undergraduate major in biological or physical sciences. Applicants with course deficiencies may be required to take appropriate undergraduate courses in the basic sciences without program credit.

*Program requirements:* thesis option—thesis and 24 credits including NRS 500. Nonthesis option—permission of chairperson, 36 credits with a minimum of 14 credits in natural resources science to include NRS 500 and 591, three credits in statistics, and a written master's examination. NRS 591 will require a substantial paper involving significant independent research. Additional prerequisite courses in the basic sciences may be required prior to admission to a degree program.

### Doctor of Philosophy (Biological Sciences)

Limited to soil science and organic geochemistry specializations.

*Admission requirements:* GRE and M.S. degree with thesis in biological or physical science.

*Program requirements:* dissertation, advanced courses determined in consultation with the candidate's committee, and comprehensive examination.

### NRS Courses

#### Natural Resources Science

- 401 Forested Watershed Hydrology (II, 3)
- 402 Wildlife Biometrics (II, 3)
- 406 Wetland Wildlife Management (II, 3)
- 410 GIS Methods in Environmental Management (I, 3)
- 412 Soil-Water Chemistry (II, 3)
- 423 Wetland Ecology (I, 4)
- 424 Wetlands and Land Use (II, 4)
- 444 Current Issues in Natural Resources Policy (I, 3)
- 450 Soil Conservation and Land Use (II, 3)
- 451 Soil and Water Conservation Technology (I, 3)
- 461 Hydrology and Water Management (I, 4)
- 471 Soil Morphology and Mapping (I, 3)
- 475 (or PLS 475) Plant Nutrition and Soil Fertility (II, 4)
- 484 Structures (II, 3)
- 491, 492 Special Projects (I and II, 1–3 each)
- 500 Graduate Seminar in Natural Resources (II, 1) Presentation of research reports and discussion of current topics in natural resources. Critique of research meth-

odology and scientific literature. (*Lec. 1*) *Pre: graduate standing. Attendance is required of all resident graduate students, but no more than 2 credits may be taken for program credits. S/U credit. Eddleman*

### 505 Biology of Management of Migratory Birds (I, 2)

Current programs, problems, and techniques for managing migratory game and nongame birds. Emphasis on basic biology of the species, habitat management, and harvest management. (*Sem. 2*) *Pre: 305 or permission of instructor. In alternate years. Next offered 1993–94. Eddleman*

**510 Soil-Water Relations (II, 3)** Processes governing water flow and availability in unsaturated and saturated soil. Emphasis on soil-water-plant relationships with applications to watershed management and hydrology. (*Lec. 2, Lab. 3*) *Pre: 212, 461, or permission of instructor. Gold*

**512 Chemistry of Soils and Sediments (II, 4)** Discussion of inorganic and organic compounds and their reaction in soils. Role of mineral and biochemical cycles in soil productivity. Modern techniques of laboratory experimentation and analysis. (*Lec. 3, Lab. 3*) *Pre: 212, CHM 212 and 227, or permission of instructor. Staff*

**514 Fate of Organic Chemicals in Soils and Sediments (II, 3)** Physical and chemical processes which determine contaminant distribution in soils and sediments, along with mechanistic conceptual models of these processes. Soil-water-contaminant relationships are emphasized. (*Lec. 3*) *Pre: one semester of organic chemistry and permission of instructor. Gamerding*

**522 Advanced GIS Analysis of Environmental Data (II, 3)** Discussion and applications of terrain modeling, spatial statistics, proximity analysis, remote sensing/GIS linkages, and environmental data integration. Emphasis on ecological data at watershed/landscape scales. (*Lec. 1, Lab. 6*) *Pre: 410 or permission of instructor. August*

**523 Water Pollution Microbiology**  
See Microbiology 523.

**524 Wetland Mapping and Evaluation (II, 3)** Identification, delineation, and classification of wetlands on aerial photographs. Wetland map preparation, wetland evaluation, and compilation and interpretation of inventory and evaluation data using a team approach. Independent field work. (*Lec. 1, Lab. 4*) *Pre: 423. In alternate years. Next offered 1994–95. Golet*

**526 Microbial Ecology of Soils and Sediments (I, 3)** Occurrence and activity of microorganisms in soils and sediments, including wetlands. Environmental physiology of microbes; habitat interactions; methods of study; importance of microbial processes to ecosystem productivity, pollutant degradation, and atmospheric chemistry. (*Lec. 3*) *Pre: 212, MIC 211, or permission of instructor. Staff*

**532 Conservation Biology (II, 2)** Examination of the different components of conservation of biological diversity. Topics include genetics of small populations, minimum viable population sizes, captive propagation reintroduction ecology, and causes of extinction. (*Lec. 2*) *Pre: BOT (or ZOO) 262 or permission of instructor. In alternate years. Next offered spring 1994. August*

**534 Ecology of Fragmented Landscapes (II, 2)** Presentation of the concepts of landscape ecology with emphasis on populations of plants and animals in fragmented habitats. Topics discussed include: habitat corridors, fluxes of energy and species along habitat edges, shape analysis, and stability of populations in habitat patches. (*Lec. 2*) *Pre: BOT (or ZOO) 262 or permission of instructor. In alternate years. Next offered spring 1995. August*

**555 Applied Coastal Ecology (I, 2)** Resource management problems in coastal national parks. Topics include air and water pollution, barrier island erosion, deer overpopulation, Lyme disease, and ecosystem restoration. Examples of conflicting land-management mandates and research needs discussed. Optional field trips. (*Lec. 2*) *Pre: advanced course work or experience in topical fields or permission of instructor. Offered in even-numbered years. Buckley, Ginsberg, and Roman*

**567 Soil Genesis and Classification (II, 3)** Development of soils as influenced by physical, chemical, biological, and climatic factors. Processes of soil formation presented relative to soil taxonomy and geographic distribution. (*Lec. 3*) *Pre: 471 or permission of instructor. Wright*

**568 Recent Advances in Natural Resources Science (I, 3)** Critical analysis and presentation of technical reports on recent advances in natural resources science. Topics will vary according to instructor and background of students. (*Lec. 3*) *Pre: graduate standing or permission of instructor. In alternate years. Next offered 1993-94. Staff*

**591, 592 Special Problems (I and II, 1-3 each)** Advanced independent research projects supervised by members of the research staff and unrelated to thesis research. Projects developed to meet individual needs. *Pre: permission of chairperson. Staff*

**599 Master's Thesis Research I, II (I and II)** Number of credits is determined each semester in consultation with the major professor or program committee. *S/U credit.*

**699 Doctoral Dissertation Research I, II (I and II)** Number of credits is determined each semester in consultation with the major professor or program committee. *S/U credit.*

## Nursing

M.S., Ph.D.  
401-792-2766

### Graduate Faculty

*Dean:* Professor Jean Miller, R.N., Ph.D., 1975, University of Washington  
*Director of Graduate Studies:* Professor Donna Schwartz-Barcott, R.N., Ph.D., 1978, University of North Carolina  
Professor Janet I. Hirsch, R.N., Ed.D., 1978, Boston University  
Professor Hesook S. Kim, R.N., Ph.D., 1977, Brown University  
Professor Norma Jean Schmieding, R.N., Ed.D., 1983, Boston University  
Associate Professor Cheryl Beck, R.N., D.N.Sc., 1982, Boston University  
Associate Professor Jacqueline D. Fortin, R.N., D.N.Sc., 1984, Boston University  
Associate Professor Marion Garey, R.N., Ed.D., 1985, Boston University  
Associate Professor Dayle Hunt Joseph, R.N., Ed.D., 1982, Boston University  
Associate Professor Margaret McGrath, R.N., D.N.Sc., 1988, Boston University  
Assistant Professor Christine Bridges, R.N., D.N.Sc., 1987, Boston University  
Assistant Professor Patricia M. Burbank, R.N., D.N.Sc., 1988, Boston University  
Assistant Professor Marlene A. Dufault, Ph.D., 1983, University of Connecticut  
Assistant Professor John Twomey, R.N., Ph.D., 1993, University of Virginia  
Clinical Assistant Professor Denise Fimbel-Coppa, R.N., M.S., 1979, University of Colorado  
Professor Emerita Barbara L. Tate, R.N., Ed.D., 1961, Teachers College, Columbia University  
Associate Professor Emerita Concepcion Y. Castro, R.N., Ed.D., 1984, Boston University

### Specializations

*For the M.S.:* education, administration, mental health care, primary health care, and clinical practice (with emphasis on critical care, gerontological nursing, or parent-child nursing, and nurse-midwifery).

*For the Ph.D.:* clinical nursing research in the domains of client, client-nurse interactions, and nursing practice.

### Master of Science

*Admission requirements:* MAT or GRE; a bachelor's degree from an NLN-accredited program with an upper-division major in nursing and an undergraduate course in statistics. For specialization in primary health care—two years of professional nursing practice. For specialization in midwifery—two years of professional nursing practice in maternity and completion of a course in expanded assessment skills in

nursing, including newborn and pediatric assessment and equivalent of NUR 503 and 504. Students who have not completed upper-division undergraduate nursing course work will be required to make up this deficiency prior to admission. Completed application package must be received by November 15 for spring admission and April 15 for summer and fall admission.

*Program requirements:* 40 credits for education, administration, mental health, and clinical practice specialization; 41 credits for primary health care specialization; 45 credits for midwifery concentration, including 16 credits in core courses—NUR 501, 502, 505, 507, 510, and 520; 15-26 credits in the area of specialization—NUR 521, 522, 541, 542 for education; NUR 521, 522, 551, 552 for administration; NUR 511, 512, 513, 514 for mental health care; NUR 531, 532, 533, 534 for primary health care; NUR 521, 522, 561, and 562 or 563 or 564 for clinical practice; and NUR 571, 572, 573, 574, 575, 576, 577 for midwifery; nine credits of restricted electives related to the area of specialization, except for midwifery, which requires three credits, and primary health care, which requires 10 credits, including ZOO 442 or equivalent, NUR 503 and 504, and three credits of electives related to the area of specialization; a major paper involving significant independent study; and a written comprehensive examination.

### Doctor of Philosophy

*Admission requirements:* GRE (scores at 60th percentile or above are desirable); a bachelor's degree from an NLN-accredited program or its equivalent in nursing and a master's degree in nursing or its equivalent (cumulative averages of 3.00 and 3.30, respectively, are desirable); two scholarly papers (one theoretical and one empirical) or a master's thesis or equivalent; three recommendations for doctoral study including one by a doctorally prepared person; a statement of purpose indicating goals congruent with those of the program and institution; and a course in statistics including inferential statistics.

*Program requirements:* a minimum of 61 credits including core courses in nursing (19 credits) and cognates (six credits); electives in nursing (six credits) and research methods (six credits); free electives (six credits); and the doctoral dissertation (at least 18 credits), plus written and oral comprehensive exams in nursing theory, research methods, and one substantive area. Reading comprehension of a foreign language is required. This requirement may be waived for those students for whom another research tool would prove more relevant to the area of research.

## NUR Courses Nursing

### 459 Perspectives on Male and Female Sexuality (I or II, 3)

**501 Theoretical Study of Phenomena in Nursing (I, 3)** Major theories and concepts in nursing. Emphasis on the theoretical study of nursing phenomena commonly found in client and client-nurse systems. (Lec. 3) *Pre: graduate standing and concurrent enrollment in 502.* Beck and Dufault

**502 Practicum in the Study of Phenomena in Nursing (I, 3)** Field study of selected nursing phenomena in health care agencies. Emphasis on the clinical application of selected theoretical or conceptual frameworks. (Lab. 6) *Pre: graduate standing and concurrent enrollment in 501.* Beck and Dufault

**503 Expanded Nursing Assessment Skills (I and II, 3)** Expansion of nursing assessment skills including health history taking and physical, psychological, and social assessment skills. Specific physical assessment skills included are inspection, auscultation, percussion, and palpation. (Lec. 2, Lab. 3) *Pre: graduate standing or permission of instructor.* Fimbel-Coppa or Sweat-Carley

**504 Expanded Nursing Assessment Skills: Pediatrics (I, 1)** Application of expanded nursing assessment skills to children. Includes assessment of growth and development, psychosocial, cognitive, and physical well-being of children of all age groups. *Pre: credit or concurrent enrollment in 503 or permission of instructor.* Fimbel-Coppa or McGrath

**505 Nursing Research (I or II, 3)** An overview and analysis of current research in nursing with special focus on patient care. Students will design a research project. (Lec. 3) *Pre: a course in statistics, credit or concurrent enrollment in 501, 502, or permission of instructor.* Fortin or Kim

**506 Independent Study in Nursing (I and II, 2–6)** Intensive study of a specific area of interest, a problem or issue in nursing under guidance of the faculty. *Pre: permission of graduate faculty.* Staff

**507 Theories of Practice for Nursing (II, 3)** Analysis of general theories of practice for nursing and their applicability to various areas of clinical practice. (Lec. 3) *Pre: 501, 502, or permission of instructor.* Hirsch or Burbank

**510 Nursing Leadership in the Health Policy Process (II, 3)** Study of nurses' participation in the health policy process. Focus on theories for the development of nursing leaders. Analysis and application of creative nursing strategies for the enhancement of health care. (Lec. 3) *Pre: graduate standing.* Hirsch and Schmieding

**511 Advanced Mental Health Nursing I (II, 3)** Investigation of theories of healthy and psychopathological patterns of individual behavior from a mental health perspective. (Lec. 3) *Pre: 501 and 502 and credit or concurrent enrollment in 512.* Garey

**512 Practicum in Advanced Mental Health Nursing I (II, 3)** Field experience to develop competence in the practice of advanced mental health nursing. Emphasis on application of relevant theories in solving individuals' mental health problems. (Lab. 6) *Pre: 501 and 502 and concurrent enrollment in 511.* Garey

**513 Advanced Mental Health Nursing II (I, 3)** Theoretical analysis of current modes of advanced mental health intervention in order to explain strategies for solution of family, group, and community problems. (Lec. 3) *Pre: 511, 512, and concurrent enrollment in 514.* Garey

**514 Practicum in Advanced Mental Health Nursing II (I, 6)** Field experience to develop increased competence in the practice of mental health nursing intervention. (Lab. 12) *Pre: 511, 512, and concurrent enrollment in 513.* Garey

**520 Graduate Study Seminar (I or II, 1)** A seminar designed to facilitate the synthesis and examination of information learned in the master's program about nursing knowledge development, advancement of nursing practice, and leadership role development. (Sem. 1) *Pre: completion of 30 graduate program credits and concurrent enrollment in the final sequence of concentration courses.* Hirsch and Garey

**521 Theoretical Study of Major Problems in Nursing Practice (II, 3)** Major theories and concepts for developing strategies in nursing practice. Emphasis on developing nursing strategies through theoretical analysis of problems viewed in the context of organizational and societal systems. (Lec. 3) *Pre: 501, 502, and concurrent enrollment in 522.* Dufault

**522 Practicum in the Study of Major Problems in Nursing Practice (II, 3)** Field study of major nursing problems with emphasis on examination, evaluation, and revision of nursing strategies for problems in the context of organizational and societal systems. (Lab. 6) *Pre: 501, 502, and concurrent enrollment in 521.* Dufault

**531 Primary Health Care Nursing I (II, 3)** Theoretical knowledge and skills for the development of nursing strategies in analyzing, managing, and preventing health-related problems common to primary health care clients. (Lec. 3) *Pre: 501, 502, 503, and ZOO 442.* Fimbel-Coppa and Sweat-Carley

**532 Practicum in Primary Health Care Nursing I (II, 3)** Clinical application of theoretical knowledge and skills as presented in 531. (Lab. 6) *Pre: concurrent enrollment in 531.* Fimbel-Coppa and Sweat-Carley

**533 Primary Health Care Nursing II (I, 3)** Theoretical study for the development of increased nursing competency in primary care practice. Emphasis on health care strategies to assist individuals and families in coping with health-related problems. (Lec. 3) *Pre: 531, 532, and concurrent enrollment in 534.* Fimbel-Coppa

**534 Practicum in Primary Health Care Nursing II (I, 6)** Application of theoretical knowledge and skills for the development of nursing strategies for health promotion and management of health-related problems common to families. (Lab. 12) *Pre: 531, 532, and concurrent enrollment in 533.* Fimbel-Coppa and Sweat-Carley

**541 Theoretical Study of Nursing Education (I, 3)** Investigation of theories, concepts, and models applicable to nursing education. Emphasis on theoretical analysis to develop and explain strategies for the teaching of nursing. (Lec. 3) *Pre: 521, 522, permission of instructor, and concurrent enrollment in 542.* In alternate years. Next offered 1993–94. Hirsch

**542 Practicum in Nursing Education (I, 6)** Field experience in nursing education. Emphasis on the instructional design and the development of strategies for the teaching of nursing based on theoretical knowledge. (Lab. 12) *Pre: 521, 522, or permission of instructor, and concurrent enrollment in 541.* In alternate years. Next offered 1993–94. Hirsch

**551 Theoretical Study of Nursing Administration (I, 3)** Study of theories of organization and management as they relate to nursing administration. Emphasis on theories to develop or explain management strategies in nursing administration. (Lec. 3) *Pre: 521, 522, or permission of instructor, and concurrent enrollment in 552.* In alternate years. Next offered 1993–94. Schmieding

**552 Practicum in Nursing Administration (I, 6)** Field experience in nursing administration. Emphasis on the examination, development and implementation of strategies in nursing administration. (Lab. 12) *Pre: 521, 522, or permission of instructor, and concurrent enrollment in 551.* In alternate years. Next offered 1993–94. Schmieding

**560 Ethical Theories, Nursing Practice, and Health Care (I or II, 3)** Analysis of philosophic positions, ethical theories, and moral principles important to professional nurses in their clinical, educative, and administrative practice. (Sem. 3) *Pre: B.S. or B.A. in a health-related field, one course in philosophy and ethics, or permission of instructor.* Staff

**561 Theories of Practice for Clinical Nursing (I, 3)** Intensive analysis of theories of practice as applied to clinical nursing. Emphasis on theoretical knowledge of the nurse system phenomena in professional clinical nursing. (Lec. 3) *Pre: 501, 502, 521, and 522, and concurrent enrollment in 562, 563, or 564.* In alternate years. Next offered 1994–95. Hirsch

**562 Advanced Clinical Study of Nursing Practice in Critical Care (I, 6)** Study and application of the theories of practice and of biopsychosocial interaction in advanced critical care nursing. Analysis of patient problems and nursing strategies relevant to critical care patients. (*Lab. 12*) *Pre: 501, 502, and credit or concurrent enrollment in 561. In alternate years. Next offered 1994-95.* Fortin

**563 Advanced Clinical Study of Nursing Practice in Gerontology (I, 6)** Study and application of the theories of practice and of aging in advanced gerontological nursing. Analysis of central health problems and nursing strategies relevant to older people. (*Lab. 12*) *Pre: 501, 502, and credit or concurrent enrollment in 561. In alternate years. Next offered 1994-95.* Burbank

**564 Advanced Clinical Study of Nursing Practice in Parent-Child Health (I, 6)** Study and application of normal developmental and biopsychosocial stress theories in advanced clinical parent-child health nursing. Analysis of problems and nursing strategies relevant to parents and children. (*Lab. 12*) *Pre: 501, 502, and credit or concurrent enrollment in 561. In alternate years. Next offered 1994-95.* Hirsch and McGrath

**569 Theoretical Study of Advanced Nursing (I, 3)** Theoretical foundations of advanced nursing practice. Emphasis is on the reciprocal nature of the relationship between theories, client problems, and nursing strategies in the areas of advanced practice. (*Lec. 3*) *Pre: 507, 521, 522, and concurrent enrollment in 562, 563, or 564, or permission of instructor. First offered fall 1994.* Staff

**571 Theoretical Study of Well Women's Health Care (II, 3)** A study of major theories, client issues, and nurse-midwifery strategies used in the care of well women seeking gynecological health care. (*Lec. 3*) *Pre: 501, 502, and concurrent enrollment in 572.* Staff

**572 Practicum: Theoretical Study of Well Women's Health Care (II, 3)** Clinical application of the theoretical knowledge and interventions in the care of well women in ambulatory health care settings. (*Lab. 3*) *Pre: concurrent enrollment in 571.* Staff

**573 Theoretical Study of the Childbearing Woman and Her Family (II, 3)** Within a systems perspective, theories are utilized to examine client issues related to the normal childbirth experience. Knowledge and skills relevant to nurse-midwifery strategies of normal childbirth are emphasized. (*Lec. 3*) *Pre: credit or concurrent enrollment in 571, 572; concurrent enrollment in 574.* Staff

**574 Practicum: Theoretical Study of the Childbearing Woman and Her Family (II, 3)** Theoretical application of nurse-midwifery strategies during the normal childbirth experience. Knowledge and skills relevant to patient care are emphasized. (*Lab. 3*) *Pre: concurrent enrollment in 573.* Staff

**575 Advanced Practice: Collaborative Nurse-Midwifery (I, 3)** Within a systems perspective, theories are utilized to examine client issues of the at-risk childbirth experience. Expanded nurse-midwifery strategies related to collaborative practice within the community are emphasized. (*Lec. 3*) *Pre: concurrent enrollment in 576.* Staff

**576 Advanced Practice: Collaborative Nurse-Midwifery (I, 6)** Field study of the clinical application of theoretical knowledge and skills in the at-risk childbirth experience. Use of collaborative practice and the management process within communities is emphasized. (*Lab. 3*) *Pre: concurrent enrollment in 575.* Staff

**577 Practice and Integration of Nurse-Midwifery (I or II, 5)** Comprehensive and practical application of clinical skills and theoretical knowledge in nurse-midwifery. Complete integration of the nurse-midwifery role with the client, family, and community. (*Lab.*) *Pre: 575 and 576.* Staff

**590 Directed Advanced Study and Clinical Practice in Primary Health Care (I or II, 3)** In-depth study and supervised clinical practice in a specialized area of primary health care of the student's choice. (*Lab.*) *Pre: 531 and 532 and permission of instructor.* Fimbel-Coppa

**601 Foundations of Nursing Science (II, 3)** Analysis of the nature of nursing knowledge from the historical and epistemological perspectives. Focus on examination of theoretical, ethical, and methodological foundations of the development of nursing science. (*Lec. 3*) *Pre: doctoral standing in nursing.* Kim

**602 Construction of Nursing Theory I: Inductive Process (II, 4)** Study of inductive approaches to generating theory relevant to nursing science. Examination of multidisciplinary strategies for generation of theory from field data. (*Lec. 2, Lab. 4*) *Pre: doctoral standing in nursing, 601, or permission of instructor.* Schwartz-Barcott

**603 Construction of Nursing Theory II: Deductive Process (I, 3)** Study of deductive theory-building as applied to nursing science. Focus on the nature of deductive theories and the application of deductive process to nursing theory construction. (*Lec. 3*) *Pre: doctoral standing in nursing, 601, or permission of instructor.* Kim

**621 Nursing Theory and Research in the Client Domain (I, 3)** In-depth, comparative analysis of existing nursing theories and research relevant to the client domain. Development of a research proposal for validation of a selected nursing theory. (*Lec. 3*) *Pre: doctoral standing in nursing and completion of core courses in nursing.* Schwartz-Barcott

**631 Nursing Theory and Research in the Client-Nurse Domain (I or II, 3)** Study of theoretical and research work in the client-nurse domain. Formulation and testing of hypotheses dealing with client-nurse phenomena. (*Lec. 2, Lab. 2*) *Pre: doctoral standing*

*in nursing and completion of core courses in nursing.* Staff

**641 Nursing Theory and Research in the Practice Domain (I, 3)** In-depth analysis of theoretical and research work in the nursing domain of practice. The expansion and refinement of knowledge for nurse-system phenomena of the practice domain. (*Lec. 3*) *Pre: doctoral standing in nursing and completion of core courses in nursing.* Kim

**651 Advanced Methods in Nursing Research I (I, 3)** In-depth study of theories and methods in sampling, research design, data collection, and data analysis, and their application to qualitative research in nursing. Emphasis on qualitative data collection methods. (*Lec. 3*) *Pre: doctoral standing in nursing, advanced statistics course, or permission of instructor.* Fortin

**652 Advanced Methods in Nursing Research II (II, 3)** In-depth study of application of theories and methods in sampling, research design, data collection, data analysis for quantitative and evaluative research in nursing. (*Lec. 3*) *Pre: doctoral standing in nursing, 651, or permission of instructor.* Fortin

**653 Measurement and Instrument Development in Nursing Research (II, 3)** In-depth study of theories and methods relevant to measurement and instrument development for nursing and health sciences. Emphasis on measurement as an ongoing process of successive approximation, refinement, and validation. (*Lec. 3*) *Pre: completion of 652 or permission of instructor.* Fortin

**654 Ethnographic Approaches in Health and Nursing Research (I or II, 3)** Examination of various ethnographic approaches that have emerged from anthropological fieldwork and their current and potential application in health and nursing research. (*Lec. 3*) *Pre: 651 or permission of instructor.* Schwartz-Barcott

**660 Philosophical Foundations for Health Care Research (I, 3)** Presentation of the historical and philosophical basis of contemporary health care research. (*Lec. 3*) *Pre: doctoral standing in nursing or permission of instructor.* Burbank

**671 Role Development in Nursing Research (II, 3)** In-depth examination of the role of the nurse researcher as a member of a multidisciplinary team and in academia. Emphasis on theories and issues related to researcher role development. (*Lec. 2, Lab. 2*) *Pre: doctoral standing in nursing, 601, 602 or 603, and 660.* Joseph and McGrath

**699 Doctoral Dissertation Research (I or II)** Number of credits is determined each semester in consultation with the major professor or program committee. *S/U credit.*

**995 Reading and Research in Nursing (I or II, 1-6)** Advanced work by individual student on a selected issue in nursing under the direction of a faculty member. (*Lec. 1-6*) *Pre: graduate standing. S/U credit.* Staff

## Ocean Engineering

M.S., Ph.D.  
401-792-2273

### Graduate Faculty

*Chairperson:* Professor Malcolm L. Spaulding, Ph.D., 1972, University of Rhode Island  
*Director of Graduate Studies:* Professor Peter R. Stepanishen, Ph.D., 1969, Pennsylvania State University  
Professor Richard Brown, Ph.D., 1977, University of Cambridge  
Professor Peter C. Cornillon, Ph.D., 1973, Cornell University  
Professor Armand J. Silva, Ph.D., 1965, University of Connecticut  
Professor Robert C. Tyce, Ph.D., 1976, University of California, Scripps Institution of Oceanography  
Professor Frank White, Ph.D., 1959, Georgia Institute of Technology  
Professor Raymond M. Wright, Ph.D., 1981, Pennsylvania State University  
Associate Professor Stephen Grilli, Ph.D., 1985, University of Liege  
Associate Professor Sau-Lon James Hu, Ph.D., 1984, Rice University  
Adjunct Professor David H. Shonting, Ph.D., 1966, Massachusetts Institute of Technology

### Specializations

Ocean instrumentation and data analysis, marine hydrodynamics, marine geomechanics, coastal and nearshore processes, coastal and offshore structures, remote sensing, composite materials and corrosion, and underwater acoustics.

### Master of Science

*Admission requirements:* B.S. degree in engineering, physics, applied mathematics, or other technical disciplines. Students with a nonengineering background may be required to make up deficiencies by taking undergraduate courses in thermodynamics, fluid mechanics, strength of material, electrical circuits, or applied mathematics.

*Program requirements:* Core requirements of four courses selected from OCE 510, 512, 521, 522, 534, 560, 561, 565, 571, 587, one course selected from OCG 501, 521, or 540, or an advanced-level oceanography course. Thesis option—a total of 30 credits, including core requirements plus thesis and at least nine credits of electives exclusive of OCE 605, 606. Nonthesis option for part-time students—permission of chairperson; a total of 33 credits, including core requirements plus 18 credits exclusive of OCE 605, 606, but including at least one course requiring a substantial paper involving significant independent study; and a written master's examination.

### Doctor of Philosophy

*Admission requirements:* M.S. degree in engineering or equivalent; exceptional students with a Bachelor of Science will also be considered. All students will be required to complete the OCE and OCG core courses for the M.S. degree in ocean engineering if equivalent courses are not included in their master's degree.

*Program requirements:* Ph.D. qualifying examination, dissertation, one advanced applied mathematics course, one graduate-level course in another department, one additional oceanography and two additional ocean engineering courses. Students entering with a master's degree will be required to complete a minimum of 30 credits of course work including the above-noted courses. Students entering with a bachelor's degree will be required to complete at least 60 credits, which also includes the courses required for the M.S. in ocean engineering.

### Special Financial Aid

Graduate and research assistantships are available for highly qualified students. Some industrial and other fellowships are also available.

### General Information

Programs of study can be designed for individuals who are employed on a full-time basis.

### OCE Courses Ocean Engineering

403, 404 (or CHE 403, 404) **Introduction to Ocean Engineering Processes I, II** (I and II, 3 each)  
410 **Basic Ocean Measurements** (I or II, 3)  
411 **Basic Coastal Measurements** (I, 3)  
483 (or CVE 483) **Foundation Engineering** (II, 3)

510 **Engineering Ocean Mechanics** (II, 3) Fundamental equations of estuarine and coastal hydrodynamics. Scaling of governing equations. Long period waves including seiches, tides, storm surges, and tsunamis. Wind- and estuarine-induced circulation. Pollutant and sediment transport. (Lec. 3) Pre: MCE 354 or equivalent. Spaulding

514 **Engineering Wave Mechanics and Nearshore Processes** (I, 3) Linear water wave boundary value problem. Engineering wave properties. Nonlinear waves (long waves, Stokes waves, stream function waves). Nearshore hydrodynamics and wave breaking. Fully nonlinear transient waves. (Lec. 3) Pre: MCE 455 or equivalent. Grilli

522 **Dynamics of Waves and Structures** (I, 3) Deterministic analysis for SADOF structures; MDOF dynamic analysis; distributed-parameter systems; linear and second-order Stokes wave theories; wave forces on cylinders; chaotic vibration of marine struc-

tures. (Lec. 3) Pre: MCE 464 or permission of instructor. Hu

534 **Corrosion and Corrosion Control** See Chemical Engineering 534.

535 **Advanced Course in Corrosion** See Chemical Engineering 535.

537 **Advanced Materials Engineering** See Chemical Engineering 537.

555, 556 **Ocean Energy Systems I, II** (I and II, 3 each) Theory and design of energy extraction from the oceans. Types of ocean power available; principles and systems of energy extraction; design and construction principles. Design project of a power device will be carried out in the second semester. (Lec. 3) Pre: MCE 345 and 354 or equivalent. Brown

560 **Introduction to Data Collection Systems** (II, 3) Practical problems of data collection. Probes and sensors, interfaces, signal conditioning, and storage. Examples found among the current research areas within ocean engineering will be emphasized. (Lec. 3) Pre: graduate standing in engineering or permission of instructor. Stepanishen

561 **Introduction to the Analysis of Oceanographic Data** (I, 3) Design of oceanic experiments to determine spatial and temporal sampling rate, precision, accuracy, signal-to-noise ratio, etc. Description of typical ocean data collection and analysis systems. Development of relevant techniques. (Lec. 3) Pre: IDE 411, MTH 451, or equivalent. Stepanishen

565 **Ocean Laboratory I** (I or II, 3) Measurements, experiments, operation of apparatus in the ocean and in the laboratory. Statistical theory, planning multivariable experiments, checking of data, etc. (Lec. 1, Lab. 6) Pre: graduate standing in engineering or oceanography, or permission of instructor. Tyce

571 (or ELE 571) **Underwater Acoustics I** (I, 3) Introduction to sound generation, transmission, and reception, including vibration of mechanical systems, acoustic waves in fluids, acoustic transducers and arrays, acoustic propagation in the ocean, and sonar systems. (Lec. 3) Stepanishen

581 **Experimental Geomechanics** See Civil and Environmental Engineering 581.

582 (or CVE 582) **Seabed Geotechnics** (I or II, 3) Geotechnical engineering principles as applied to submarine slope stability, bearing capacity, anchoring; emphasis on effective stress principle, compressibility, and shear strength of marine sediments. (Lec. 3) Pre: CVE 381 or equivalent. Silva

583 **Advanced Foundation Engineering** See Civil and Environmental Engineering 583.

**591, 592 Special Problems (I and II, 1-6 each)** Advanced work under the supervision of a staff member arranged to suit the individual requirements of the student. (*Lec. or Lab. according to nature of problem*) *Pre: permission of chairperson. Staff*

**599 Master's Thesis Research (I and II)** Number of credits is determined each semester in consultation with the major professor or program committee. *S/U credit.*

**605, 606 Ocean Engineering Seminar (I and II, 1 each)** Seminar discussions including presentation of papers based on research or literature survey. (*Lec. 1*) *Required of all resident graduate students. May be repeated for a maximum of 2 nonprogram credits. S/U credit. Staff*

**611 Coastal and Estuarine Modeling (I, 3)** Numerical modeling techniques to solve problems in coastal and estuarine circulation and pollutant transport. Application of models to predict tidal, wind, and density-forced circulation, constituent and sediment transport, oil and chemical spill transport. (*Lec. 3*) *Pre: 510 or permission of instructor. Spaulding*

**614 Coastal Modeling (II, 3)** Mild slope equation. Parabolic wave equation. Harbor oscillations and wave field modeling (refraction—diffraction). Nearshore hydrodynamic models. Fully nonlinear wave model (boundary elements) and applications. (*Lec. 3*) *Pre: 514. Grilli*

**623 Random Waves and Vibrations (II, 3)** Random ocean waves; random wave kinematics and forces; wave kinematics near ocean surface; linear and second-order random wave theories; wave simulations; linear random vibration; nonlinear stochastic dynamic analysis. (*Lec. 3*) *Pre: 522. Hu*

**661 Analysis of Oceanographic Data Systems (I, 3)** Design of systems for deep-ocean and estuarine data collection and processing. Space-time sampling, multivariate analysis, and convergence of moments as applied to ocean data estimation and system design. Current topics in ocean data systems. (*Lec. 3*) *Pre: ELE 506 or equivalent. Stepanishen*

**666 (566) Ocean Laboratory II (I, 3)** Advanced design/laboratory course in ocean mapping and instrumentation. Students work as a team designing and deploying ocean instrumentation, including sonars, navigation systems, vessels, buoys, underwater sensors, and locations of opportunity. (*Lab. 6-8*) *Pre: 565 or permission of instructor. Tyce*

**672 (or ELE 672) Underwater Acoustics II (II, 3)** Sound transmission in ocean, transducers, active signal design for range and Doppler resolution, ambient and platform noise, classical and wave vector-frequency methods of beamforming, adaptive beamforming, characteristics of targets, and active/passive systems. (*Lec. 3*) *Pre: 571. Stepanishen*

**673 Advanced Course in Underwater Acoustic Propagation (I, 3)** Analysis of propagation from a concentrated acoustic source in the ocean by methods such as advanced normal mode theory, numerical integration, and Fast Fourier Transforms. Applications to ocean features such as surface ducts, shadow zones, deep-sound channel, etc. (*Lec. 3*) *Pre: 571 or equivalent. Stepanishen*

**674 Nonlinear Acoustics (I or II, 3)** Topics in the nonlinear acoustics of fluids, propagation and interactions of finite-amplitude sound waves, parametric sonar, sound generation by turbulence, cavitation noise, shock waves, underwater explosions, radiation pressure and acoustic streaming. (*Lec. 3*) *Pre: 571 or permission of instructor. Stepanishen*

**675 Processing of Underwater Acoustic Data (II, 3)** Description of the underwater acoustic environment. Methods of measuring underwater acoustic signals. Data analysis of passive and active signals. Applications of underwater acoustics to oceanographic survey. (*Lec. 3*) *Pre: ELE 506 or equivalent. Stepanishen*

**676 Acoustic Radiation from Underwater Vibrators (I or II, 3)** Fundamentals of acoustic radiation from submerged structures. Radiation from planar, cylindrical, and spherical surfaces. In-vacuo and in-fluid vibration of elastic bodies. Acoustic coincidence and fluid-loading effects on radiation from elastic bodies. *Pre: 571 or permission of instructor. Stepanishen*

**677 (or ELE 677) Statistical Sonar Signal Processing (I or II, 3)** Basic results in probability and statistics, signal processing, and underwater acoustics are applied to the design of detection, estimation, and tracking in active sonar, passive sonar, and underwater acoustic communication. (*Lec. 3*) *Pre: MTH 451 or ELE 509, ELE 506, and ELE 571 (or OCE 571), or equivalents. ELE 510 is useful and closely related, but not required. Stepanishen or Tufts*

**688 (or CVE 688) Marine Geomechanics (I or II, 3)** Integrated study of marine geotechnics and marine geology. Topics include sedimentary processes, acoustic characteristics, slope stability, consolidation and stress history, engineering properties and other subjects related to seabed utilization. (*Lec. 3*) *Pre: CVE 381 or permission of instructor. Silva*

**689 (or CVE 689) Selected Topics in Geomechanics (I or II, 3)** Advanced topics in geotechnical engineering, including state-of-the-art techniques, methods of analysis and design with applications to professional practice. Specific topic(s) will be selected based on student interest. (*Lec. 3*) *Pre: CVE 381 or equivalent. Kovacs, Silva, and Veyera*

**691, 692 Special Problems (I and II, 1-6 each)** Advanced work under supervision of a staff member arranged to suit the individual requirements of the student. (*Lec. or Lab. according to nature of problem*) *Pre: permission of chairperson. Staff*

**699 Doctoral Dissertation Research (I and II)** Number of credits is determined each semester in consultation with the major professor or program committee. *S/U credit.*

## Oceanography

M.S., Ph.D.

401-792-6246

### Graduate Faculty

*Dean:* Professor Margaret Leinen, Ph.D., 1979, University of Rhode Island  
*Associate Dean:* Professor James A. Yoder, Ph.D., 1979, University of Rhode Island  
 Professor Michael L. Bender, Ph.D., 1970, Columbia University  
 Professor Peter Cornillon, Ph.D., 1973, Cornell University  
 Professor Ann G. Durbin, Ph.D., 1976, University of Rhode Island  
 Professor Edward G. Durbin, Ph.D., 1976, University of Rhode Island  
 Professor Paul J. Fox, Ph.D., 1972, Columbia University  
 Professor Paul E. Hargraves, Ph.D., 1968, College of William and Mary  
 Professor Barry J. Huebert, Ph.D., 1970, Northwestern University  
 Professor Dana R. Kester, Ph.D., 1969, Oregon State University  
 Professor Roger L. Larson, Ph.D., 1970, University of California, San Diego  
 Professor Scott W. Nixon, Ph.D., 1969, University of North Carolina  
 Professor Candace A. Oviatt, Ph.D., 1967, University of Rhode Island  
 Professor Michael E.Q. Pilson, Ph.D., 1964, University of California, San Diego  
 Professor James G. Quinn, Ph.D., 1967, University of Connecticut  
 Professor Kenneth A. Rahn, Ph.D., 1971, University of Michigan  
 Professor Hans T. Rossby, Ph.D., 1966, Massachusetts Institute of Technology  
 Professor Jean-Guy Schilling, Ph.D., 1966, Massachusetts Institute of Technology  
 Professor Haraldur Sigurdsson, Ph.D., 1970, Durham University  
 Professor Theodore J. Smayda, Dr.Philos., 1967, University of Oslo  
 Professor Elijah Swift V, Ph.D., 1967, Johns Hopkins University  
 Professor Robert C. Tyce, Ph.D., 1976, Scripps Institution of Oceanography  
 Professor D. Randolph Watts, Ph.D., 1973, Cornell University  
 Professor Mark Wimbush, Ph.D., 1969, Scripps Institution of Oceanography

Professor Howard E. Winn, Ph.D., 1955, University of Michigan  
 Professor Karen Wishner, Ph.D., 1979, Scripps Institution of Oceanography  
 Associate Professor Jeremy S. Collie, Ph.D., 1985, Massachusetts Institute of Technology and Woods Hole Oceanographic Institution  
 Associate Professor John King, Ph.D., 1983, University of Minnesota  
 Associate Professor John T. Merrill, Ph.D., 1976, University of Colorado  
 Associate Professor Lewis M. Rothstein, Ph.D., 1983, University of Hawaii  
 Assistant Research Professor Richard Arimoto, Ph.D., 1981, University of Connecticut  
 Assistant Professor Steven N. Carey, Ph.D., 1983, University of Rhode Island  
 Assistant Professor Steven D'Hondt, Ph.D., 1990, Princeton University  
 Assistant Professor Tetsu Hara, Ph.D., 1990, Massachusetts Institute of Technology  
 Assistant Professor David L. Hebert, Ph.D., 1988, Dalhousie University, Canada  
 Assistant Professor Brian G. Heikes, Ph.D., 1984, University of Michigan  
 Assistant Professor Christopher R. Kincaid, Ph.D., 1989, Johns Hopkins University  
 Professor Emeritus H. Perry Jeffries, Ph.D., 1959, Rutgers—The State University  
 Professor Emeritus John A. Knauss, Ph.D., 1959, University of California  
 Professor Emeritus Saul B. Salla, Ph.D., 1952, Cornell University  
 Professor Emeritus John McN. Sieburth, Ph.D., 1954, University of Minnesota  
 Associate Professor Emeritus Theodore A. Nopora, Ph.D., 1964, Yale University

### Specializations

Biological, chemical, geological, and physical oceanography.

### Master of Science

*Admission requirements:* GRE (aptitude required, advanced in the applicant's undergraduate major recommended) and bachelor's degree in natural sciences or engineering. Most applicants are admitted for September, but admission for the start of the second semester is possible. Due to the limited number of students that can be accepted as degree candidates, no application will be considered which shows an undergraduate average of less than B unless there is postbaccalaureate work indicating outstanding ability. To ensure full consideration for admission and financial support, the completed application packet should be received by January 15.

*Program requirements:* thesis, OCG 695, a minimum of six credits of 500- or 600-level oceanography courses outside the student's specialization; participation in a regular ocean research cruise.

### Doctor of Philosophy

*Admission requirements:* GRE (aptitude required, advanced in the applicant's undergraduate major recommended); bachelor's degree in natural sciences or engineering. Most applicants are admitted for September, but admission for the start of the second semester is possible. Due to the limited number of students that can be accepted as degree candidates, no application will be considered which shows an undergraduate average of less than B unless there is postbaccalaureate work indicating outstanding ability. To ensure full consideration for admission and financial support, the completed application packet should be received by January 15.

*Program requirements:* comprehensive examination; dissertation; participation in a regular ocean research cruise; six credits of 500- and 600-level OCG courses outside the specialization; six credits of 600-level OCG courses (excluding problems and research courses and OCG 695). For a specialization in biological and chemical oceanography—OCG 501, 521, 540, 561; for a specialization in geological oceanography—OCG 541, 542 and any two of OCG 501, 521, 561; and for a specialization in physical oceanography—OCG 501, 510, 605, 613. A Ph.D. qualifying examination is required of all doctoral students. This requirement is satisfied by completing, with a grade of B or better, the four courses specified for the appropriate discipline.

### Special Financial Aid

There is a limited number of assistantships for master's and doctoral candidates.

### General Information

It is anticipated that approximately 25 students will be admitted to the program for the 1993–94 academic year.

### OCG Courses Oceanography

#### 401 General Oceanography

(I and II, 3 each)

#### 483, 484 Laboratory and Research Problems in Physics

#### 491 Ocean Studies (I and II, 15 each)

#### 493, 494 Special Problems and Independent Study in Oceanography (I and II, 1–6 each)

**501 Physical Oceanography (I, 3)** Basic course covering physical properties of seawater, heat budget, distribution of variables, dynamics, water masses and general circulation, waves and tides. (Lec. 3) Pre: PHY 213 and MTH 141. Hebert

**510 Descriptive Physical Oceanography (II, 3)** Observed distributions of temperature, salinity, currents; methods of deducing deep flow; physical properties of seawater; flow in estuaries; practical work in the analysis of oceanographic data; study of recent literature. (Lec. 3) Pre: 501. Rossby

#### 521 Chemical Oceanography (II, 3)

Processes regulating the composition of seawater and the distribution of chemical species. The interaction of marine chemistry with the ocean floor, atmosphere, and marine organisms. (Lec. 2, Lab. 2) Pre: CHM 101 and 112 and PHY 213. Pilson

#### 523 Organic Geochemistry of Natural Waters (I, 3)

Chemistry of organic matter in natural waters with emphasis on the marine environment. Topics include a consideration of the origin, nature, and biogeochemical reactions of organic matter in aquatic environments. (Lec. 3) Pre: CHM 228 or permission of instructor. Offered in odd-numbered years. Quinn

#### 524 Chemistry of the Marine Atmosphere (II, 3)

Chemistry and physics of marine aerosols, trace gases, and precipitation; cycles and budgets of atmospheric nitrogen, sulfur, halogen, and carbon compounds; effects of man on the marine atmosphere. (Lec. 3) Pre: 521 and CHM 432 or permission of instructor. In alternate years. Next offered 1995. Staff

#### 531 Synoptic and Dynamic Meteorology (I, 3)

Observed structure of atmosphere; principles of balanced flows, waves, and disturbances. Observations and models of storm formation, semipermanent features, and general circulation. Relationship between weather and climate. (Lec. 3) Pre: PHY 203 or permission of instructor. Merrill

#### 540 Geological Oceanography (II, 3)

Origin and evolution of the ocean basin and its margin: morphology, structure, plate tectonics, volcanism, geochemistry, stratigraphy, sedimentation, and paleoceanography. (Lec. 2, Lab. 2) Pre: GEL 103 or 105 or permission of instructor. Staff

#### 541 Principles of Marine Geology and Geophysics (I, 4)

Origin, structure, and evolution of ocean basins including plate kinematics, lithospheric origin and dynamics, volcanism, and geochemistry. (Lec. 3, Lab. 1) Pre: GEL 103 or 102 and 106. Larson and Staff

#### 542 Principles of Marine Geology and Geophysics (II, 4)

Marine sedimentary processes, paleo-oceanography, and paleoclimatology and evolution of the Mesozoic-Cenozoic global ocean. (Lec. 3, Lab. 1) Pre: GEL 103. Staff

#### 561 Biological Oceanography (I, 3)

Nature of life in the sea; adaptations, patterns of distribution and production of plankton, nekton, and benthos, their interrelationships and interaction with the environment. (Lec. 2, Lab. 2) Pre: ZOO 111. Oviatt

#### 574 Biology of Marine Mammals (I, 3)

Migration, reproduction, social organization, classification, anatomy, populations, physiology, and communications of cetaceans and pinnipeds. (Lec. 2, Lab. 2) Pre: permission of instructor. In alternate years. Next offered 1994. Winn

**576 (or MIC 576) Marine Microbiology (I, 4)** The role of bacteria, fungi, apochlorotic algae, flagellates, sarcodines, and ciliates in the cycling of organic matter is discussed in the context of their structure, habitats, trophic modes, ecology, processes, and taxonomy. (Lec. 3, Lab. 3) *Pre: CHM 112 and MIC 201 or 211 or permission of instructor. Offered in odd-numbered years.* Staff

**581 Topics in Tectonic Geology**  
See Geology 581.

**599 Master's Thesis Research (I and II)**  
Number of credits is determined each semester in consultation with the major professor or program committee. *S/U credit.* Staff

**605 Dynamical Oceanography (II, 3)**  
Simple steady-state theories applied to ocean motion. Review of well-known force balances in oceanography, wind-driven circulation, thermohaline circulation, the thermocline, oceanic boundary layers, near-shore circulation, diffusion. (Lec. 3) *Pre: 501.* Watts

**606 Aquatic Community Ecology (II, 3)**  
Lectures and discussion of controversial topics contrasting marine and freshwater communities. Current topics of interest will vary on a yearly basis. *Pre: permission of instructor.* A. Durbin, E. Durbin, or Twombly

**607 Geophysical Models (I, 1–4)** Selected laboratory experiments modeling the motions of oceans and atmospheres. Comparison of effects of rotation and stratification. Thermal and thermohaline convection, inertial waves and boundary layer phenomena. Emphasis on experimental research techniques and preparation of technical reports. (Lab. 2–8) *Pre: 610 or permission of instructor. May be repeated for a maximum of 4 credits.* Staff

**610 Geophysical Fluid Dynamics I (I, 3)**  
Natural world fluid dynamics emphasizing ocean circulation. Classical fluid dynamics; GFD fundamentals (rotation and stratification); Taylor-Proudman theorem; potential vorticity; planetary waves; geostrophic contours; shallow water quasi-geostrophic theory; frictional layers. (Lec. 3) *Pre: 606 or permission of instructor.* Hara

**611 Geophysical Fluid Dynamics II (II, 3)**  
Continuously stratified quasi-geostrophic theory; classical and modern theories of the wind-driven ocean circulation; stability theory; oceanic convection; wave-mean flow interactions; ageostrophic dynamics; topographical effects. (Lec. 3) *Pre: 610 or permission of instructor.* Rothstein

**613 Waves (II, 3)** Generation, propagation, and decay of surface waves, internal waves, and Rossby waves in the ocean. (Lec. 3) *Pre: MCE 550 or permission of instructor.* Wimbush

**614 Tides (I, 2)** Generation, propagation, and dissipation of ocean tides. Earth tides. Relation between theory and observation. Tidal analysis. (Lec. 2) *Pre: 501.* Wimbush

**620 Chemical Distributions (II, 3)** Interdisciplinary study of the processes responsible for oceanic chemical distributions with emphasis on conservative properties, biologically active constituents, and radionuclides. Includes projects involving data processing analysis. (Lec. 3) *Pre: 501, 521, 540, and 561 or permission of instructor.* Kester

**623 Physical Chemistry of Seawater (I, 3)**  
Characterization of dissociation, solubility, and redox equilibria in seawater. Partial molar volumes, conductivity, and diffusion of ions in seawater. Kinetic studies in seawater; effect of temperature, salinity, and pressure on physicochemical properties in seawater. (Lec. 3) *Pre: 521 and CHM 432 or permission of instructor. Offered in odd-numbered years.* Next offered fall 1995. Kester

**625 Organic Geochemistry of Sediments (I, 3)**  
Chemistry of organic matter in recent to ancient sediments. Topics include the source, characterization, significance and fate of sedimentary organic compounds with emphasis on the marine environment. (Lec. 3) *Pre: 523 or permission of instructor.* Offered in even-numbered years. Quinn

**628 High-Temperature Geochemistry (I, 3)**  
Principles and factors governing the distribution of trace elements in volcanic processes. Applications to the study of rock genesis, mantle dynamics, oceanic crust formation, and hotspots. (Lec. 3) *Pre: CHM 431 or equivalent, or permission of instructor.* Offered in even-numbered years. Next offered fall 1994. Schilling

**631 Seminar in Marine and Atmospheric Chemistry (I and II, 1)** Discussion of problems of current interest in marine chemistry. (Lec. 1) *Pre: 521 or permission of instructor.* *S/U credit.* Staff

**641 Geology of Continental Margins (I, 3)**  
Continental margin formation and evolution within lithospheric plates and at plate boundaries with emphasis on structural patterns, stratigraphic relationships, depositional sequences, and tectonics. (Lec. 3) *Pre: 540, GEL 370 and 550.* In alternate years. Staff

**643 Subduction Zones (II, 3)** Structure, petrology, and geochemistry of subduction zones, island arcs, and other magmatic arcs at convergent plate margins. Petrogenesis of andesites and related magmas. (Lec. 3) *Pre: 540 or permission of instructor.* Sigurdsson

**644 Global Paleoclimatology (I, 3)**  
Principles of modern climatology, climate dynamics, modelling, and climate indicators with application to the geologic record; Phanerozoic climates and relationships to tectonics, paleogeography, and ocean-atmosphere composition. (Lec. 2, Sem. 1) *Pre: 510 and 540.* In alternate years. Next offered fall 1995. Leinen

**645 Petrology of the Oceanic Crust (I, 3)**  
Nature and origin of igneous and metamorphic rocks of the oceanic crust of the earth; mineralogy, petrology, and petrogenesis of sea-floor rocks; metamorphism of the ocean

crust. (Lec. 3) *Pre: graduate standing or permission of instructor.* Sigurdsson

**646 Deep-Sea Sediments and Processes (II, 3)** Deep-sea sediments and their relation to oceanic processes such as solution, productivity, and dilution. Sedimentary distributions in time and space as related to tectonic models. Paleoclimatology, and past water mass distributions and conditions. Term paper. (Lec. 3) *Pre: graduate standing or permission of instructor.* In alternate years. Next offered 1995. Leinen

**647, 648 Recent Sedimentary Environments (I and II, 3 each)** A study of sedimentary environments emphasizing the relationships between sediment properties of each environment and its environmental conditions. 647: beach, estuary, and continental shelf. 648: continental shelf-break, slope, and rise. (Lec. 3) *Pre: 501, 540, and GEL 550.* In alternate years. Staff

**649 Plankton Paleocology (I, 3)** Concepts of paleocology. Interaction between planktonic marine organisms and their environment over evolutionary time-scales. The use of fossil plankton in reconstructing paleoenvironmental conditions and paleoecological systems. Patterns, causal hypotheses, and geological consequences of temporal and geographic variation in Cretaceous and Cenozoic plankton assemblages. (Lec. 3) *Pre: permission of instructor.* In alternate years. Next offered fall 1994. D'Hondt

**651 Marine Stratigraphy (I, 3)** Concepts and methods of biostratigraphy, lithostratigraphy, and chronostratigraphy. Stratigraphic nomenclature. Stratigraphic correlation and completeness. Special focus will be placed on the integration of multiple stratigraphic techniques and their application to the Cretaceous and Cenozoic marine record. Class discussion of advances and problems in recent research articles. (Lec. 2, Lab. 1) *Pre: permission of instructor.* In alternate years. Next offered fall 1995. D'Hondt

**652 Marine Geophysics (II, 3)** Survey of basic subdisciplines of marine geophysics including plate tectonics, gravity, magnetism, heat flow reflection, and refraction seismology. Basic theory and methods of data collection and interpretation emphasized. (Lec. 3) *Pre: 540 or permission of instructor.* Staff

**653 Reflection and Refraction Seismology (I, 3)** Theory and application of marine single-channel, multichannel, and refraction seismic techniques. Topics include theory of elastic wave propagation, instrumentation, method of data collection, and travel time inversion and interpretation techniques. (Lec. 3) *Pre: 540 and 652 or permission of instructor.* Staff

**654 Seminar in Plate Tectonics (I, 3)**  
Extensive reading and seminar discussions of plate kinematics, driving forces, the rheology of the lithosphere, and topics of current research interest. Assumes familiarity with basic concepts of geology, geophysics, and vector analysis. (Sem. 3) *Pre: 540 or*

permission of instructor. Offered in odd-numbered years. Larson

**661 (or BOT 661) Phytoplankton Taxonomy (I, 3)** Classical and modern systems and techniques for the identification, nomenclature, and classification of planktonic algae, with emphasis on marine forms. Phylogeny will be briefly considered. (Lec. 1, Lab. 4) Pre: permission of instructor. In alternate years. Next offered fall 1994. Hargraves

**663 (or BOT 663) Phytoplankton Physiology (I, 3)** Metabolic processes and methods of their investigation in phytoplankton with primary emphasis on functions pertinent to their ecology. Includes adaptation, uptake of nutrients, excretion, rhythms, pigments, and photosynthesis. (Lec. 3) Pre: graduate standing or permission of instructor. Swift

**664 (or BOT 664) Phytoplankton Ecology (II, 3)** Biology and ecology of the pelagic marine microscopic algae with emphasis on their adaptations, physiological ecology, distribution, succession, production, and regional and seasonal dynamics. (Lec. 3) Pre: permission of instructor. Smayda

**665 Marine Bio-Optics and Remote Sensing (II, 3)** Bio-optical properties of ocean waters. Major focus is on basic principles of visible-band ocean remote sensing and its application to determining phytoplankton pigment and production at regional to global scales. (Lec. 3) Pre: 561. In alternate years. Next offered spring 1995. Yoder or Swift

**666 Zooplankton (II, 3)** Biology of marine zooplankton, dealing with morphology, adaptation, distribution, physiology, production, and interrelationships with other members of the marine biota. (Lec. 1, Lab. 4) Pre: permission of instructor. Staff

**667 (or BOT 667) Advanced Phytoplankton Seminar (II, 1)** Specialized and advanced areas of phytoplankton biology and research, including systematics, physiology, and ecology. (Sem. 2) Pre: graduate standing or permission of instructor. May be repeated. S/U credit. Hargraves, Smayda, and Swift

**668 Productivity of Ocean Margins (II, 3)** Processes affecting biological productivity of ocean margin waters. Major focus on dynamics of production in mid to outer shelf waters and adjacent boundary currents. (Lec. 3) Pre: 501, 561. In alternate years. Next offered spring 1994. Yoder

**669 Marine Fish Ecology and Production (II, 3)** Functioning of fishes in major world ecosystems is explored through comparison of feeding ecology, bioenergetics, and production rates. (Lec. 3) Pre: 561 or permission of instructor. A. Durbin and E. Durbin

**670 Fish Population Dynamics (II, 3)** Methods for estimating vital statistics of fish populations, stock assessment theory and methods, analytical and empirical model development, and fisheries forecasting. (Lec. 3) Pre: graduate standing or permission of instructor. Fogarty

**671 Marine Zooplankton Ecology (II, 3)** Marine zooplankton community structure and function including the relation of spatial and temporal distribution patterns to the oceanic environment, organism interactions, secondary production, feeding, and reproduction. Emphasis on open ocean communities. (Lec. 3) Pre: 561 or permission of instructor. Wishner

**672 Marine Invertebrates and Environment (I, 3)** Physiological responses of marine invertebrates to seasonal and geographical changes in the environment. Survival, metabolism, reproduction, and larval development of the populations. Mechanisms in adaptation during stages in life cycle examined in relation to changes of certain environmental factors. Physiological variation of populations related to speciation process. Lectures, reading, and discussion. Research project. (Lec. 3) Pre: 561 and permission of instructor. Staff

**678 Low-Temperature Geochemistry and Isotope Geology (II, 3)** A study of processes important in determining the chemical and isotopic mass balance of the oceans and the geochemistry of deep-sea sediments. (Lec. 3) Pre: 521. Bender

**679 (or ZOO 679) Animal Communication (I, 2)** Visual, chemical, and auditory communication in animals, including receptor systems, feedback, and redundancy. Functional aspects and organization of communication. Discussion of readings. Research problem can be taken under 691 or ZOO 693. (Lec. 2) Pre: ZOO 467 or equivalent and permission of instructor. In alternate years. Next offered 1993. Winn

**681 Marine Pollution (II, 3)** The chemical and biological processes governing the fate and effects of pollutants in the marine environment are introduced. Approaches used in the analyses and modeling of marine pollution will be introduced. (Lec. 3) Pre: 521, 561, or permission of instructor. Staff

**689 Coastal Marine Ecosystems (II, 3)** Comparative analysis of community structure in estuaries and shelf waters. Biological characterization of specific habitats with respect to general properties of the physical-chemical-geological environment. Class-developed databases for comparisons of Narragansett Bay with estuaries of the world. (Lec. 2, Lab. 1) Pre: 561. Staff

**691, 692 Individual Study (I and II, 1-6 each)** Individual study of assigned topics or special problems, involving literature search and/or original investigation under one or more members of the staff. (Lec., Lab. TBA) Staff

**693, 694 Special Studies (I and II, 1-4 each)** Studies of specialized topics in the marine sciences. (Lec., Lab. TBA) Staff

**695 Seminar in Oceanography (I and II, 1 each)** Students to give seminar reports on problems and current research in various

areas of oceanography. (Lec. 1) Attendance and registration are required of all resident graduate students, but no more than 2 credits are allowed for a program of study. S/U credit. Leinen

**699 Doctoral Dissertation Research (I and II)** Number of credits is determined each semester in consultation with the major professor or program committee. S/U credit.

**930 Workshop in Oceanography Topics for Teachers (I and II, 0-3 each)** Especially designed for teachers of physical sciences. Basic topics in oceanography from an advanced or pedagogical perspective. (Lec. or Lab.) Pre: teacher certification. Staff

Note: Graduate students in oceanography choose from supporting courses in other departments.

## Pharmaceutics

M.S., Ph.D. (Pharmaceutical Sciences)  
401-792-2754

### Graduate Faculty

Chairperson: Professor Thomas E. Needham, Ph.D., 1970, University of Rhode Island  
Professor Joan M. Lausier, Ph.D., 1971, University of Rhode Island  
Professor Louis A. Luzzi, Ph.D., 1966, University of Rhode Island  
Professor Christopher T. Rhodes, Ph.D., 1964, Chelsea College, University of London  
Associate Professor Serpil Kislalioglu, Ph.D., 1973, University of London  
Associate Professor Sara Rosenbaum, Ph.D., 1980, University of Liverpool  
Associate Professor Esmail Tabibi, Ph.D., 1982, University of Maryland  
Associate Professor Hossein Zia, Ph.D., 1966, University of Georgia

### Specializations

Pharmaceutics with emphasis on physical pharmacy, biopharmaceutics, pharmacokinetics, formulation and manufacturing of conventional, drug delivery, and cosmetic products, drug standards and regulatory affairs.

### Master of Science

Admission requirements: GRE, bachelor's degree in pharmacy or equivalent, and CSC 201 or equivalent.

Program requirements: thesis; EST 409 or equivalent; BCP 435; PHC 521, 522; nine credits of 500- or 600-level pharmaceutics courses. For the cosmetic science technology track—thesis; EST 409; BCP 435 or CHE 542; PHC 521, 522, 530, 531, 532; and 10 credits of electives with one course selected from 500- or 600-level pharmaceutics courses.

### Doctor of Philosophy (Pharmaceutical Sciences)

*Admission requirements:* same as for master's degree. Qualifying examination is required for all candidates.

*Program requirements:* dissertation; M.S. core requirements plus PHC 521, 522 and IME 533; and comprehensive examination. In addition, for the pharmaceutical formulation track—CHE 530; six credits from CHM 512, MIC 533 and 552, FSN 447, PAD 680, and CHM 511; and 10 additional credits of 500- or 600-level pharmaceutics courses. For the regulatory affairs track—PHC 535, 621, 670, 680, PCL 546, PHP 540, 680, CHM 511; six credits from PHC 622, 623, 631, 633, PHP 540, 680, CHM 511; and six credits from PHC 622, 623, 631, 633, PHP 640X, PED 564, MGT 630, MKT 601, MIC 533, 552.

### PHC Courses Pharmaceutics

**460 (or PHP 460) Nonprescription Drugs and Medical Devices (I and II, 4)**  
**497, 498 Special Problems (I and II, 1–3 each)**

**521, 522 Seminar (I and II, 1 each)** Seminar discussions including presentation of papers on selected topics in pharmacy. (*Lec. 1*) *Required of all resident graduate students, with a maximum of 1 credit allowed per year. May be repeated for a maximum of 2 credits for M.S. candidates. May be repeated for a maximum of 5 credits for Ph.D. candidates.* Rhodes

**530 Fundamentals of Cosmetic Science (I, 3)** Study of the fundamentals of the function and behavior of skin, hair, and nails and their reactivity to cosmetic raw materials. Properties of cosmetic ingredients will also be addressed. (*Lec. 3*) *Pre: permission of instructor.* Kislalioglu and Staff

**531 Basic Research in Cosmetic Science (I, 2)** Laboratory exercises in the form of individual projects designed to provide an understanding of the basic properties and behavior of skin, hair, and nails. Assessment of cosmetic product performance and the basic properties of cosmetic ingredients. (*Lab.*) *Pre: permission of instructor.* Kislalioglu and Staff

**532 Cosmetic Product Formulation (II, 2)** Provide a basic understanding of cosmetic products, technology, and quality control; improve formulation skills with a particular emphasis on the application of new technological developments in cosmetic formulation. (*Lab.*) *Pre: permission of instructor.* Kislalioglu and Staff

**535 Pharmacokinetics (II, 3)** The principles and application of clinical pharmacokinetics for advanced pharmacy students. Developing, modifying, and evaluating dosage regimens. (*Lec. 3*) Staff

**599 Master's Thesis Research (I and II)** Number of credits is determined each semester in consultation with the major professor or program committee. *S/U credit.*

**621 Manufacturing Pharmacy (I or II, 2)** Theory and practice in the manufacture of pharmaceuticals and the principles of operation of the equipment used for their production. (*Lec. 2*) Rhodes

**622 Manufacturing Pharmacy (I or II, 3)** Theories applied to the manufacture of pharmaceuticals with an emphasis on formulation considerations and principles of operation of equipment used for their production. (*Lec. 3*) *Pre: 621. In alternate years.* Needham

**623 Manufacturing Pharmacy Laboratory (I or II, 2)** Practical application of the principles of all aspects of dose-form manufacture, including an emphasis on good manufacturing procedures. *Pre: credit or concurrent enrollment in 622.* Needham

**631 Advanced Physical Pharmacy (I or II, 4)** Theory and application of physical chemical principles to problems in pharmaceutical research, with emphasis on methods by which properties of new medicinal agents are determined. (*Lec. 4*) *Pre: permission of instructor.* Zia and Staff

**633 Advanced Physical Pharmacy Laboratory (II, 1)** Laboratory exercises dealing with the physical-chemical principles used in evaluation of pharmaceutical substances. (*Lab. 4*) *Pre: CHM 435.* Staff

**670 Advanced Pharmacokinetics (I, 2)** Application of classical compartmental and noncompartmental analyses to drug absorption and disposition in linear and nonlinear systems. (*Lec. 2*) *Pre: 535 or permission of instructor.* Rosenbaum and Staff

**680 Industrial Project (Pharmaceutics) (I, II, or SS, 3)** A research project directed by the major professor on a topic in industrial pharmacy. A report must be submitted to the department faculty. The project will normally be conducted off campus. *Pre: graduate standing in pharmaceutics.* Staff

**697, 698 Research in Pharmacy (I and II, 1–3 each)** Literature survey, laboratory work, and a detailed research report on one or more assigned topics in pharmacy. (*Lab. TBA*) Staff

**699 Doctoral Dissertation Research (I and II)** Number of credits is determined each semester in consultation with the major professor or program committee. *S/U credit.*

### Pharmacognosy

M.S., Ph.D. (Pharmaceutical Sciences)  
401-792-2751

### Graduate Faculty

*Chairperson:* Professor Yuzuru Shimizu, Ph.D., 1962, Hokkaido University  
Associate Professor Ching-Shih Chen, Ph.D., 1985, University of Wisconsin  
Research Assistant Professor Lucie Maranda, Ph.D., 1987, University of Rhode Island

Adjunct Assistant Professor Mostafa M. Omar, Ph.D., 1982, University of Rhode Island

### Specializations

Biosynthesis of drug plant constituents, natural product chemistry including the isolation and structural elucidation of materials of potential medicinal interest, screening of natural products for physiologically active agents including materials from both land and marine sources.

### Master of Science

*Admission requirements:* GRE and bachelor's degree in pharmacy, chemistry, or biology.

*Program requirements:* thesis; A.C.S. placement examination (organic) to determine specific program requirement; PCG 445, 446, or equivalent; PCG 548, 551, 552; and written master's examination.

### Doctor of Philosophy (Pharmaceutical Sciences)

*Admission requirements:* GRE and master's degree in pharmacy, chemistry, or biology, or bachelor's degree in one of these with evidence of superior ability. Qualifying examination is required for candidates accepted without the master's degree.

*Program requirements:* PCG 551, 552, 633, 634, CHM 521 or equivalent. A candidate entering the Ph.D. program with a bachelor's degree must also meet the M.S. core course requirements.

### PCG Courses Pharmacognosy

**445, 446 General Pharmacognosy (I and II, 3 each)**

**459 Public Health (I, 3)**

**521, 522 Seminar (I and II, 1 each)** Seminar discussions including presentation of papers on selected topics in pharmacognosy. (*Lec. 1*) *Required of all resident graduate students, with a maximum of 1 credit allowed per year. May be repeated for a maximum of 3 credits.* Staff

**533 Medicinal Plants (I, 2)** Problems in drug plant chemotaxonomy with field work in the drug plant gardens. Emphasis is placed on certain alkaloid, glycoside, and oil-yielding plants. Weedicides and insecticides as related to measures for control. (*Lec. 1, Lab. 3*) *Pre: 446 or equivalent.* Staff

**536 Antibiotics (II, 3)** Advanced course on concept of antibiosis, biosynthesis pathways of antibiotic production, testing, chemistry, mechanism of action, medicinal and pharmaceutical uses of antibiotics. Phenomena of sensitivity and resistance; emphasis on entities of importance in pharmaceutical research and production. (*Lec. 3*) *Pre: graduate or fifth-year undergraduate pharmacy standing. In alternate years.* Staff

**548 Physical Methods of Identification**  
See Medicinal Chemistry 548.

**551, 552 Chemistry of Natural Products**  
(I and II, 3 each) Introduction to chemistry of certain groups of natural products especially in relation to their chemotaxonomic position in plant classification. Topics limited to secondary metabolites, e.g., terpenoids, phenolic compounds, aromatic compounds, phytosterols, alkaloids. (Lec. 3) Pre: CHM 228 and 230. In alternate years. Next offered 1993-94. Shimizu

**597, 598 Special Problems** (I and II, 1-3 each) Special graduate student project assignments in the study of natural drug research under the supervision of faculty. Pre: graduate standing. May be repeated for a maximum of 6 credits. Staff

**599 Master's Thesis Research** (I and II)  
Number of credits is determined each semester in consultation with the major professor or program committee. S/U credit.

**633, 634 Biosynthesis** (I and II, 3 each)  
Biogenesis of medicinally active principles of biological origin. Emphasis given to organic acids, polysaccharides, glycosides, steroids, and certain nitrogenous compounds. (Lec. 3) In alternate years. Next offered 1994-95. Staff

**635, 636 Pharmacognosy Techniques**  
(I and II, 3-4 each) Physical and chemical factors influencing growth and development of active principles of drug plants. Certain biological analyses of results are performed. (Lec. 1, Lab. 6-9) Staff

**697, 698 Research in Pharmacognosy**  
(I and II, 1-3 each) Literature survey, laboratory work, and a detailed research report on one or more assigned topics. (Lab. TBA) Staff

**699 Doctoral Dissertation Research**  
(I and II) Number of credits is determined each semester in consultation with the major professor or program committee. S/U credit.

**Pharmacology and Toxicology**  
M.S., Ph.D. (Pharmaceutical Sciences)  
401-792-2362

#### Graduate Faculty

**Chairperson:** Professor Zahir A. Shaikh,  
Ph.D., 1972, Dalhousie University,  
Canada

Professor Alvin K. Swonger, Ph.D., 1971,  
Dartmouth College

Associate Professor John R. Babson, Ph.D.,  
1980, Oregon State University

Associate Professor Clinton O. Chichester  
III, Ph.D., 1980, University of Rhode  
Island

Associate Professor Robert L. Rodgers, Ph.D.  
1977, University of Oklahoma

Adjunct Professor Alexander R. Malcolm, Jr.,  
Ph.D., 1977, University of Rhode Island

Adjunct Associate Professor Hans-Jurgen H.  
Barrach, Ph.D., 1973, Free University of  
Berlin

Adjunct Associate Professor Kim  
Boekelheide, M.D., Ph.D., 1980, Duke  
University

Adjunct Associate Professor Joseph M.  
Capasso, Ph.D., 1979, St. John's  
University

Adjunct Associate Research Professor Cecilia  
T. Giambalvo, Ph.D., 1975, University of  
Connecticut

Adjunct Associate Professor Herbert V.  
Levinsky, Ph.D., 1969, College of  
Agriculture, Vienna

Adjunct Assistant Professor Douglas O.  
Fisher, Ph.D., 1979, University of Rhode  
Island

Adjunct Assistant Professor Dennis Hilliard,  
M.S., 1980, University of Rhode Island

Adjunct Assistant Professor Eugene Jackim,  
Ph.D., 1965, St. John's University

Adjunct Assistant Professor M.A. Ravi Kiron,  
Ph.D., 1986, Indian Institute of Science,  
Bangalore, India

#### Specializations

Biochemical and cardiovascular pharmacology; biochemical and forensic toxicology.

#### Master of Science

**Admission requirements:** GRE and bachelor's degree in pharmacy, biological sciences, or chemistry.

**Program requirements:** thesis; one course in mathematics (141 or equivalent); one course in statistics; PCL 441 and 442 or equivalent; BCP 581 and 582; PCL 521 and 522 and two advanced pharmacology courses.

#### Doctor of Philosophy (Pharmaceutical Sciences)

**Admission requirements:** GRE and bachelor's or master's degree in pharmacy or science.

**Program requirements:** M.S. program requirements with two additional advanced pharmacology courses. In addition, a Ph.D. qualifying examination is required of all students admitted without an acceptable master's degree.

#### PCL Courses Pharmacology and Toxicology

**436 (or PSY 436) Psychotropic Drugs and Therapy** (I and II, 3)

**443 General Pharmacology Laboratory** (II, 1)

**444, 445, 446 General and Clinical Pharmacology and Toxicology I, II, III** (I and II, 3 each)

**497, 498 Special Problems**  
(I and II, 1-3 each)

**521, 522 Seminar** (I and II, 1 each) Seminar discussions and presentation of papers on selected topics in pharmacology. (Lec. 1) Required of all resident graduate students, with a maximum of 1 credit allowed per year. May be repeated for a maximum of 3 credits. Staff

**544 Forensic Toxicology** (I, 3) Theoretical and practical aspects of poisoning including the isolation and identification of toxic materials from pharmaceuticals, body fluids, and tissues. Isolation and identification of physiological fluids from stains, hairs, and tissue with application to forensic medicine. (Lec. 2, Lab. 3) Pre: 444, 445, and 446 or permission of instructor. In alternate years. Next offered spring 1996. Staff

**546 Advanced Toxicology** (II, 3) Toxic effects of selected drugs and other xenobiotics on physiological and biochemical processes. (Lec. 3) Pre: 441 and 442 or equivalent, or permission of instructor. In alternate years. Next offered fall 1995. Shaikh

**572 Neural Bases of Drug Action** (I, 3)  
Review of neuroanatomy, neurochemistry, and neurophysiology as they relate to drug action. (Lec. 3) Pre: 446 or equivalent or permission of instructor. In alternate years. Next offered fall 1995. Swonger

**599 Master's Thesis Research** (I and II)  
Number of credits is determined each semester in consultation with the major professor or program committee. S/U credit.

**641 Biochemical Pharmacology** (I, 3)  
Theory and application of pharmacological studies at the cellular and subcellular levels and their significance to drug action in the intact organism. (Lec. 3) Pre: 444, 445, and 446 or permission of instructor. In alternate years. Next offered fall 1994. Chichester

**642 (or BCP 642) Biochemical Toxicology**  
(II, 3) Biochemical and molecular aspects of chemically induced cell injury and chemical carcinogenesis. (Lec. 3) Pre: 444, 445, 446, and BCP 581, 582 or permission of instructor. In alternate years. Next offered spring 1995. Babson

**644 Cardiovascular Pharmacology** (II, 3)  
Cellular mechanisms of drug action as a basis for understanding therapeutic effects. Emphasis on current developments in anti-hypertensive, antiarrhythmic, antianginal, and cardiotonic drug research. (Lec. 3) Pre: 441 and 442 or 444 or permission of instructor. Next offered spring 1994. Rodgers

**697, 698 Research in Pharmacology**  
(I and II, 1-5 each) Literature survey, laboratory work, and a detailed research report on one or more assigned topics. (Lab. TBA) Staff

**699 Doctoral Dissertation Research**  
(I and II) Number of credits is determined each semester in consultation with the major professor or program committee. S/U credit.

## Pharmacy Administration

M.S.  
401-792-2734

### Graduate Faculty

*Director of Graduate Studies:* Professor Norman A. Campbell, Ph.D., 1972, University of Wisconsin  
Professor Albert H. Taubman, Ph.D., 1971, University of Pittsburgh  
Assistant Professor Paul E. Larrat, Ph.D., 1992, Brown University  
Assistant Professor Cynthia Willey, Ph.D., 1985, University of North Carolina, Chapel Hill  
Adjunct Associate Professor Charles Hachadorian, Jr., M.P.A., 1970, University of Rhode Island

### Specializations

Development and utilization of pharmacy resources in health care systems involving the organization, financing, and delivery of health care services and materials and the legal and socioeconomic constraints.

### Master of Science

*Admission requirements:* GRE or MAT and first professional degree in pharmacy.

*Program requirements:* thesis; PHP 599, 621, 622, 651, 652, EST 409, or equivalents.

### Special Financial Aid

Fellowships from the American Foundation for Pharmaceutical Education are available.

## PHP Courses Pharmacy Practice

- 406 Pharmacy Retailing (II, 3)  
453 Drug Marketing Principles (II, 2)  
455, 456 Pharmacotherapeutics I, II (I and II, 4)  
460 (or PHC 460) Nonprescription Drugs and Medical Devices (I and II, 4)  
480 Prepaid Drug Plans (I, 3)  
497, 498 Special Problems (I and II, 1-3 each)

**530 Behavioral Skills in Clinical Pharmacy (SS, 3)** Communication skills, behavioral aspects of illness, and the social and ethical considerations of clinical pharmacy. (Lec. 3) *Pre: enrollment in Doctor of Pharmacy program or permission of chairperson.* Staff

**540 Principles, Methods, and Applications of Epidemiology (I, 3)** An introduction to epidemiology, the study of health and disease in populations. Epidemiologic methods and research design for conducting and interpreting health research. (Lec. 3) *Pre: EST 307 or permission of instructor.* Willey

**570 Case Studies in Pharmacy Law (II, 3)** Case studies and a detailed analysis of the FDC, Controlled Substances Act, and health insurance laws. (Lec. 3) *Pre: 351. In alternate years.* Campbell

**599 Master's Thesis Research (I and II)** Number of credits is determined each semester in consultation with the major professor or program committee. *S/U credit.*

**621, 622 Seminar (I and II, 1 each)** Seminar discussions and presentation of papers on selected topics in pharmacy administration. (Lec. 1) *Required of all resident graduate students, with a maximum of 1 credit allowed per year. May be repeated for a maximum of 3 credits.* Staff

**651, 652 Health Care Systems I, II (I and II, 3 each)** Arrangements for utilizing pharmaceutical resources in public and private systems of health care in the United States and other countries. Variations in quality and distribution of care among socioeconomic groups. (Lec. 3) *Pre: 480 and EST 308 or 409, or equivalent.* Taubman and Campbell

**680 Legal Environment in Health Administration (I, 3)** Application of specialized statutory and regulatory provisions in federal and state law to the delivery of health care. (Lec. 3) *Pre: graduate standing.* Campbell

**697, 698 Research in Pharmacy Administration (I and II, 1-3 each)** Literature survey, laboratory work, and a detailed research report on one or more assigned topics in pharmacy administration. (Lab. TBA) Staff

## Doctor of Pharmacy

Pharm.D.  
401-792-2789

A revised program for the Doctor of Pharmacy, as first professional degree, will be implemented starting in the 1994-95 academic year. The program described below pertains only to students admitted and matriculated for the 1993-94 academic year. Individuals seeking information regarding the revised program should call the number listed above.

### Graduate Faculty

*Director of Graduate Studies:* Associate Professor Anne L. Hume, Pharm.D., 1982, Virginia Commonwealth University, MCV Campus  
Professor Michael N. Dudley, Pharm.D., 1980, University of California, San Francisco  
Associate Professor Marilyn M. Barbour, Pharm.D., 1982, University of California, San Francisco  
Associate Professor Edward J. Mattea, Pharm.D., 1974, Philadelphia College of Pharmacy and Science  
Associate Professor Norma J. Owens, Pharm.D., 1979, Philadelphia College of Pharmacy and Science

Assistant Professor Robert L. Dufresne, Ph.D., 1989, University of Rhode Island  
Assistant Professor Sandra Geletko, Pharm.D., 1988, University of the Pacific  
Assistant Professor Thomas P. Kanyok, Pharm.D., 1990, University of Kentucky, College of Pharmacy, Lexington

### Specializations

The Doctor of Pharmacy program is designed for students desiring excellence in the field of clinical pharmacy practice. It prepares students for advanced positions in practice, industry, government, clinical research, and academia. The focus of the program is on the application of pharmacotherapeutics to individual patients.

### Doctor of Pharmacy

*Program requirements:* A nonthesis program requiring 55 credits, including PHP 530, 542, 611, 612; PHC 535 and EST 409; PSY 532 or PHP 540; 12 credit hours of integrated medical science course work (PHP 671, 672) offered in conjunction with the Brown University Medical School; and 1,800 hours (24 credits) of clinical clerkship and a research project in affiliate hospitals (PHP 690). Candidates lacking acceptable undergraduate courses in pathology, anatomy, human physiology, biochemistry, immunology, and pharmacokinetics will be required to make up deficiencies. Written comprehensive examinations and presentation of the research project are required.

## PHP Pharmacy Practice Courses for Doctor of Pharmacy Program

**530 Behavioral Skills in Clinical Pharmacy (SS, 3)** Communication skills, behavioral aspects of illness, and the social and ethical considerations of clinical pharmacy. (Lec. 3) *Pre: enrollment in Doctor of Pharmacy program or permission of chairperson.* Larrat

**542 Drug-Induced Diseases (I, 2)** An overview of diseases induced or aggravated by drug therapy. The course is organized using an organ system/disease-state approach. (Lec. 2) *Pre: enrollment in Doctor of Pharmacy program or 451 and 452.* Owens

**544 Physical Assessment (II, 1)** Organ system approach to components of physical examination and evaluation. Emphasis is placed on understanding those physical signs and symptoms which may be drug induced. Practice skills are introduced. (Lec. 3) *Pre: enrollment in the Doctor of Pharmacy program or permission of instructor.* Geletko

**611, 612 Advanced Pharmacotherapeutics I, II (I, 3 each)** The clinical use of medication in a disease-oriented approach. Correlated basic concepts of pharmacology, pharmacy, pathophysiology, and biochemistry related to treatment of diseases. (Lec. 3) *Pre: enrollment in the Doctor of Pharmacy program. Last offered 1993-94.* Mattea

**671, 672 Integrated Medical Sciences I, II (I and II, 6)** The pathophysiology of the hematologic, gastrointestinal, respiratory, endocrine, renal, reproductive, supporting structure and cardiovascular systems; biomedical topics in nutrition; and the biomedical basis of infectious disease. Offered by the Brown University Program in Medicine as part of the Integrated Medical Science Sequence. (Lec. 6) *Pre: enrollment in Doctor of Pharmacy program. S/U credit. Last offered 1993-94. Staff*

**681, 682 Clinical Pharmacy Seminar I, II (I, 1 each)** Presentation made by students on appropriate advanced clinical pharmacy topics. (Sem. 2) *Pre: enrollment in the Doctor of Pharmacy program. Last offered 1994-95. Dudley*

**690 Advanced Clinical Pharmacy Clerkship and Research (I, II, and SS, 2-9)** Application and development of advanced clinical skills and knowledge, communication techniques, and clinical research. Skills refined by functioning as a clinical pharmacist in a clinical practice site under the supervision of a faculty member. (Lab. 40) *Pre: enrollment in the Doctor of Pharmacy program. Last offered 1994-95. Owens*

## Philosophy

M.A.

401-792-2418

### Graduate Faculty

*Chairperson:* Professor Galen A. Johnson, Ph.D., 1977, Boston University  
 Professor Yong Choon Kim, Ph.D., 1969, Temple University  
 Professor John F. Peterson, Jr., Ph.D., 1965, Indiana University  
 Professor Stephen D. Schwarz, Ph.D., 1966, Harvard University  
 Professor Fritz Wenisch, Ph.D., 1968, University of Salzburg  
 Professor Donald J. Zeyl, Ph.D., 1972, Harvard University  
 Associate Professor James G. Kowalski, Ph.D., 1975, University of Notre Dame  
 Associate Professor Lynn Pasquerella, Ph.D., 1985, Brown University  
 Assistant Professor Cheryl A. Foster, Ph.D., 1992, University of Edinburgh  
 Assistant Professor Mark Roberts, Ph.D., 1987, University of Dallas  
 Professor Emeritus John W. Hanke, Ph.D., 1967, Indiana University  
 Professor Emeritus William Young, B.Litt., 1958, University of Oxford

### Specializations

Programs of study are offered in the following general areas: logic and philosophy of science, axiology, and history of philosophy.

## Master of Arts

*Admission requirements:* GRE and 18 credits in basic philosophy courses. Students whose undergraduate preparation did not include at least 18 credits in basic philosophy courses will be required to take these in addition to the graduate program requirements.

*Program requirements:* thesis option—24 credits in course work, six credits in master's thesis research. Nonthesis option—30 credits in course work, comprehensive examination. Students in both options will normally include six credits in disciplines other than philosophy. Proficiency in a foreign language will be required if the student's program committee considers it essential for the thesis topic or the substantial paper involving significant independent research to be written by students choosing the nonthesis option.

## PHL Courses Philosophy

**401, 402 Special Problems (I and II, 3 each)**

**414 Advanced Studies in Ethics (I or II, 3)**

**440 Philosophy of Language (I or II, 3)**

**451 Symbolic Logic (I or II, 3)**

**453 Philosophy of the Social Sciences (II, 3)**

**502, 503 Tutorial in Philosophy (I and II, 3 each)** Discussion by the staff and advanced students of research problems in philosophy. Presentation and criticism of original papers. (Lec. 3) *Pre: graduate standing or permission of instructor. May be repeated for a maximum of 9 credits. Staff*

**513 General Axiology (I or II, 3)** Intensive historical and systematic study of issues such as the nature and kinds of values, their ontological status, their relation to culture, their relation to emotions, relation of axiology to other disciplines. (Lec. 3) *Pre: graduate standing or permission of instructor. In alternate years. Wenisch or Staff*

**530 Philosophy of Plato (I or II, 3)** Selected dialogues from the later period. Particular attention will be given to the areas of metaphysics, epistemology, cosmology, and ethics. (Lec. 3) *Pre: graduate standing or permission of instructor. In alternate years. Zeyl*

**531 Philosophy of Aristotle (I or II, 3)** Selected texts with emphasis on the major concepts of Aristotle's metaphysics, theory of knowledge, and ethics. (Lec. 3) *Pre: graduate standing or permission of instructor. In alternate years. Zeyl*

**542 Advanced Studies in Patristic and Scholastic Philosophy (I or II, 3)** Intensive studies of one or more thinkers belonging to the patristic or scholastic tradition. The specific subject may change from year to year. (Lec. 3) *Pre: graduate standing or permission of instructor. In alternate years. Peterson or Roberts*

**551 Philosophical Logic (I or II, 3)** Intensive consideration of such issues as the nature, structure, and function of propositions, predication, analysis of the "is" relation. Relation between proposition and facts. Nature of logic and criterion of the logical, relation of logic to language, psychology, and ontology. (Lec. 3) *Pre: graduate standing or permission of instructor. In alternate years. Kowalski or Staff*

**555 Philosophy of the Arts and of Literature (I or II, 3)** An intensive study of one or more thinkers concerned with philosophical problems arising from our experience of the arts and of literature. The phenomenological tradition will be stressed. (Lec. 3) *Pre: graduate standing or permission of instructor. In alternate years. Foster or Staff*

**570 Philosophy of Immanuel Kant (I or II, 3)** Intensive analysis of major texts. Special attention will be given to *The Critique of Pure Reason*. (Lec. 3) *Pre: graduate standing or permission of instructor. In alternate years. Peterson or Staff*

**580 Nineteenth-Century Philosophy (I or II, 3)** Intensive analysis of the work of a major philosopher or philosophical movement. Attention will be given to such major figures as Hegel, Kierkegaard, C.S. Peirce, or James. The specific subject changes from year to year. (Lec. 3) *Pre: graduate standing or permission of instructor. In alternate years. Foster, Johnson, or Staff*

**582 Advanced Studies in Contemporary Philosophy (I or II, 3)** Intensive studies of one or more thinkers of philosophical movements of the twentieth century. The specific subject may change from year to year. (Lec. 3) *Pre: graduate standing or permission of instructor. In alternate years. Johnson or Staff*

**599 Master's Thesis Research (I and II)** Number or credits is determined each semester in consultation with the major professor or program committee. *S/U credit.*

## Physical Education

M.S.

401-792-2976

### Graduate Faculty

*Chairperson:* Associate Professor Jeannette E. Crooker, M.S., 1959, University of Rhode Island  
 Professor Lorraine C. Bloomquist, Ed.D., 1974, Boston University  
 Professor Greta L. Cohen, Ed.D., 1981, Boston University  
 Professor Thomas Manfredi, Ph.D., 1976, University of Massachusetts  
 Professor Raymond A. Nedwidek, Ed.D., 1965, University of Pittsburgh  
 Professor Robert J. Sonstroem, Ph.D., 1968, University of Minnesota

Associate Professor Leo E. O'Donnell, Ed.D., 1970, Temple University  
 Associate Professor John O'Leary, M.S., 1963, Southern Connecticut State College  
 Associate Professor J. Richard Polidoro, D.P.E., 1969, Springfield College  
 Associate Professor Mark J. Rowinski, Ph.D., 1976, Medical College of Georgia  
 Associate Professor Diane Seleen, Ed.D., 1981, Boston University  
 Adjunct Assistant Professor Carol Ewing Garber, Ph.D., 1990, University of Connecticut, Storrs

### Specializations

Physical education, teacher education and administration, exercise science, adapted physical education, psychological aspects of sport and health, and international sport and physical education.

### Master of Science

**Admission requirements:** MAT or GRE with B.S. degree in physical education, health and physical education, or health education. In exceptional cases, a candidate without a major in physical education or a related area but with a strong emphasis in physical education is accepted.

**Program requirements:** thesis—30 credits, including PED 530, 531, 599, and six credits from physical education courses outside the area of specialization. Nonthesis option—33 credits, including PED 530, 531, 591, and six credits from physical education courses outside the area of specialization; a written master's comprehensive examination. In addition to the program requirements, all students choosing the international sport and physical education specialization must select 12 credits from PED 526, 592, and REN 595 or PSC 431. Students choosing the nonthesis option in this specialization must select an additional six credits from PED 560, RCR 485, and REN 595 or PSC 431.

### PED Courses

#### Physical Education

**410 Corrective and Adapted Physical Education (I and II, 3)**

**430 Adapted Aquatics (I, 3)**

**450 Theoretical Aspects of Track and Field Athletics (II, 3)**

**475 Women in Sports (I or II, 3)**

**480 Application of Biomechanics to Coaching Athletics (I or II, 3)**

**510 Current Issues in Physical Education, Health, and Recreation (I or II, 3)** Designed to develop student awareness of contemporary situations that are of concern to the above professions. Extensive review of contemporary literature. Critical analysis of selected issues, their components, and effects. (Lec. 3) Pre: permission of instructor. Polidoro

**520 Curriculum Construction in Physical Education (I or II, 3)** Analysis of criteria and procedures for curriculum construction in physical education. Standards for the evaluation and revision of elementary and secondary school physical education courses. (Lec. 3) Pre: permission of instructor. Crooker

**525 Comparative Physical Education and Sport (I or II, 3)** Examination of the status and practice of sport and physical education in selected countries. Emphasis on comparative analyses in developed and third world countries. (Lec. 3) Pre: graduate standing or permission of instructor. Polidoro

**526 Sport and International Relations (I or II, 3)** An examination of the role that sport plays in promoting international relations. Special lectures, readings, library research on topics relating to sport and international relations. (Lec. 3) Pre: graduate standing or permission of instructor. Polidoro

**530 Research Methods and Design in Health and Physical Education (I or II, 3)** Introduction to methodology in experimental, laboratory, curriculum, action, and historical research. (Lec. 3) Pre: competence in basic statistics and permission of instructor. Sonstroem and O'Donnell

**531 Advanced Experimental Techniques in Physical Education (II, 3)** In-depth analysis of research studies in the field. Advanced research technique studied and applied to problems in physical education. (Lec. 3) Pre: 530 or permission of instructor. Sonstroem

**550 Administration of Physical Education (I or II, 3)** Problems and procedures for administering a physical education program studied from the viewpoint of the physical education administrator, the school administrator, and the faculty. Emphasis is placed on the study of administrative cases. (Lec. 3) Pre: 380 or permission of instructor. Nedwidek, Polidoro, or Crooker

**551 Sport and Recreation Operations (I or II, 3)** Analysis of operational problems and policies associated with interscholastic, intercollegiate, professional, community, and commercial sports enterprises. (Lec. 3) Pre: 380 or graduate standing. Nedwidek and Crooker

**552 Supervision of Physical Education and Health Instruction (I or II, 3)** Principles, techniques, and procedures involved in effective supervision of physical education and health instruction, with emphasis on the leadership role of the supervisor in the improvement of instruction. Pre: graduate standing or permission of instructor. (Lec. 3) Nedwidek

**559 Principles of Exercise Testing and Interpretation (I or II, 3)** Theory and practical application of exercise testing and interpretation. Includes information on testing of athletes as well as clinical testing and interpretation. (Lec. 3) Pre: ZOO 343 or permission of instructor. Manfredi or Staff

**560 (or HLT 560) Seminar in Health, Physical Education, and Recreation (I or II, 3)** Selected topics within the three areas, depending on availability of specialized instruction including visiting professorship. (Lec. 3) Pre: permission of instructor. Staff

**562 Advanced Exercise Physiology (I or II, 3)** Advanced study of the physiological factors limiting physical performance and work capacity with emphasis on the effects of physical conditioning on health and fitness. (Lec. 3) Pre: ZOO 343 or permission of instructor. Manfredi

**563 Fitness Programs for the Middle-Aged and Elderly (I or II, 3)** Provides the professional physical educator with an in-depth knowledge of scientific principles applicable to the administration of adult physical fitness programs. Client characteristics, screening, program supervision, liability, recruitment, and adherence. (Lec. 3) Pre: graduate standing or permission of instructor. Staff

**564 Physiology of Aging (I or II, 3)** Library searches, reports, and discussion of topics of current research on the physiology of aging. Subject matter adapted to meet interests of staff and students. (Lec. 3) Pre: ZOO 242 or permission of instructor. Manfredi

**565 Cardiovascular Rehabilitation (I or II, 3)** Focus on cardiac rehabilitation, underlying pathology and pathophysiology, diagnostic and prognostic testing, and principles of rehabilitation. Special emphasis on exercise intervention and lifestyle change. (Lec. 3) Pre: ZOO 343 or permission of instructor. Manfredi or Staff

**570 (or HLT 570) Major Health Problems and Curriculum Planning in Health Education (I or II, 3)** Major health problems related to personal and community health with emphasis on health education, curriculum planning, and evaluation. (Lec. 3) Pre: permission of instructor. O'Donnell

**575 Principles of Motor Learning (I or II, 3)** Study of processes and conditions involved in the learning of motor skills. Includes contemporary models of skill learning with emphasis on developmental, environmental, and individual factors that influence skill acquisition. (Lec. 3) Pre: EDC 312 or equivalent or graduate standing. Staff

**578 Sport in American Culture (I or II, 3)** A survey of contemporary themes relating to the study of human behavior in sports contexts in American culture. (Lec. 3) Pre: graduate standing or permission of instructor. Cohen

**580 Physical Education: Mentally Retarded and Learning Disabled (I or II, 3)** Contributions of physical education to the growth and development of the mentally retarded and learning disabled. Theoretical and practical aspects of programs to best serve their individual needs. (Lec. 3) Pre: permission of instructor. Bloomquist

**581 Psychological Aspects of Healthy Lifestyle (I or II, 3)** Psychosocial variables involved in health maintenance and recovery from disease with emphasis on compliance in exercise. A review of models and research identifies client needs and counseling methods. (*Lec. 3*) *Pre: graduate standing, PSY 113 and 232, or permission of instructor.* Sonstroem

**582 Sport Psychology (I or II, 3)** Counseling and psychotherapeutic techniques to improve athletic performance. Considers needs of the athlete arising from competitive stress, staleness, failure, team structure, and interactions. (*Lec. 3*) *Pre: graduate standing, PSY 113 and 232, or permission of instructor.* Sonstroem

**585 Adapted Physical Activities for Special Populations (I, 3)** Characteristics and needs for special populations: retarded, emotionally disturbed, learning disabled, sensory impaired, and obese. Adapted activities based on individual needs. Effects of federal legislation on programs discussed. (*Lec. 3*) *Pre: permission of instructor.* Bloomquist

**591 (or HLT 591) Special Problems (I or II, 3)** Written paper reporting an in-depth investigation of a pertinent problem in the field, including a review of relevant literature, analysis, and solution of the problem based on scientific methodology, with recommendations for improved practices. *Limited to and required of all graduate students in physical education who elect the nonthesis option.* Staff

**592 (or HLT 592 or RCR 592) Internship in Physical Education (I, II, or SS, 3)** Directed field experience under the supervision of a faculty member and a professional staff member of the cooperating institution. Application of knowledge, synthesis of practical experiences. Paper required. *Pre: a minimum of 12 graduate credits in physical education and permission of major professor and chairperson.* Staff

**595 (or HLT 595) Independent Study (I or II, 3)** Development of an approved project supervised by a member of the graduate faculty. *Pre: permission of chairperson and instructor. May not be substituted for 591 or 599.* Staff

**599 (or HLT 599) Master's Thesis Research (I and II)** Number of credits is determined each semester in consultation with the major professor or program committee. *S/U credit.* Staff

## HLT Courses Health

**457 (or CNS 457) Health and Safety Issues of Consumer Products (I or II, 3)**

**459 Birth Defects: Family and Community Health Perspectives (SS, 3)**

**560 Seminar in Health, Physical Education, and Recreation**  
See Physical Education 560.

**570 Major Health Problems and Curriculum Planning in Health Education**  
See Physical Education 570.

**591 Special Problems**  
See Physical Education 591.

**592 Internship**  
See Physical Education 592.

**595 Independent Study**  
See Physical Education 595.

**599 Master's Thesis Research**  
See Physical Education 599.

## RCR Courses Recreation

**416 Aging and Leisure (I or II, 3)**

**485 Planning and Supervision of Recreational and Athletic Facilities (I or II, 3)**

**592 Internship**  
See Physical Education 592.

## Physical Therapy

M.S.  
401-792-5001

*Director:* Associate Professor Mark J. Rowinski, Ph.D., 1976, Medical College of Georgia  
Assistant Professor James Agostinucci, Sc.D., 1988, Boston University  
Assistant Professor Peter R. Blanpied, Ph.D., 1989, University of Iowa  
Assistant Professor Deidre E. Robinson, M.S., 1989, Northeastern University  
Assistant Professor Susan E. Roush, Ph.D., 1990, University of Washington

The physical therapy program is an entry-level Master of Science program that prepares students for the state professional licensure examination. There is an emphasis on the development of clinical skill and research capability through the three-year graduate study plan.

### Specializations

Research activities are focused on tissue biomechanics, neuromuscular control, muscle performance, and neurological rehabilitation. Clinical therapeutic skill is enhanced by faculty clinical practice and regional internships.

### Master of Science

*Admission requirements:* GRE (aptitude test scores at the 50th percentile or above are desired) and a bachelor's degree with 12 credits of biological sciences (including a minimum of six credits of human anatomy and human physiology); physical sciences (preferably 16 credits, eight in chemistry and eight in physics); six credits of social sciences (including general and developmental psychology); three credits in math-

ematics (preferably precalculus); and three credits in communications (preferably writing or speech). Courses in abnormal psychology, computer science, exercise physiology, and statistics are strongly recommended but not required.

A clinical experience with a physical therapist is required. The experience should include observing and aiding a physical therapist in treatment or evaluation procedures. The minimum number of hours recommended for the clinical experience is 30-40 hours of voluntary or paid time. The experience may be part of field work study for credit in a health-related discipline. Evidence of such experience should be documented by a letter of recommendation from the physical therapist addressing the nature and duration of the experience. This letter of recommendation should be submitted as part of the application process. Baccalaureate requirements must be completed prior to final acceptance into the master's program. The completed application package must be received by January 15. While applications will be reviewed as early as December 15, applicants will be admitted for September only.

*Program requirements:* A minimum of 83 credits of specified physical therapy course work, including 15 credits of internship. This program is a three-year plan of required course work, with the first two semesters at the 400 and 500 levels (29 credits), followed by four semesters and a summer session of graduate-level course work, including an internship at an affiliated institution between the second and third year. As for all internships, the student may have to pay living expenses for summer internships. Internships also require immunization for the hepatitis B virus and instruction in HIV precautions, as required by OSHA standards. Immunization is at the student's expense. Though essentially a nonthesis program, a substantial paper involving significant independent research is required. A course in statistical methods, EST 307 or its equivalent, is required prior to or concurrent with the first semester of the second year of the program. All course work involving clinical skill development requires skill competency testing via practical examination. All clinical competencies determined necessary by the faculty of the respective course must be demonstrated as adequately learned by the student in these courses for achievement of an adequate scholastic course grade. (See "Scholastic Standing," page 16.) Master's comprehensive examination. Courses required during the first two semesters may be waived, with an equivalent reduction in credits required for the degree, if acceptable grades have been earned in the course(s) prior to final acceptance into graduate status, and if approved by the program faculty.

## PHT Courses

### Physical Therapy

**410 Human Anatomy and Histology (I, 5)**

**413 Applied Anatomy (I, 1)**

**412 Basic Physical Evaluation, Therapeutic Exercise, and Care (I, 3)**

**417 Psychosocial Needs of the Disabled (I, 2)**

**418 Professional and Community Practices in Physical Therapy (I, 1)**

**420 Physiological Basis of Physical Therapy (I, 3)**

**422 Pathophysiology and Medical Management of Movement Disorders (II, 3)**

**430 Human Neurosciences and Neurology (II, 4)**

**510 Biomechanics and Pathokinesiology (II, 3)** Principles, theories, and recent investigations of the biomechanics of human motion and posture are presented to develop analytical skills for normal and abnormal movement evaluation. (*Lec. 2, Lab. 3*) *Pre: 410, 412, 420, or permission of instructor.* Blanpied

**513 Directed Study in Physical Therapy (I, II, and SS, 1–3)** Subject matter arranged to meet the individual needs of graduate students in physical therapy under the supervision of staff. (Method of instruction varies according to nature of study.) *Pre: permission of instructor.* Staff

**515 Research Methods in Physical Therapy (I, 3)** Research design and methods in current physical therapy theory development and scientific literature. Preparation of a research proposal through review of literature and pilot study of selected research methods are required. (*Lec. 3*) *Pre: credit or concurrent enrollment in EST 307 or equivalent and second-year standing in physical therapy or permission of instructor.* Rowinski and Blanpied

**518 Ethical, Legal, and Interdisciplinary Issues of Clinical Practice (I, 2)** Standards, ethical considerations, and legal implications of physical therapy practice. Communication with other health care disciplines and governmental agencies for the provision, progression, and implementation of physical therapy services. (*Lec. 2*) *Pre: second-year standing in physical therapy or permission of instructor.* Roush

**525 Research Projects in Physical Therapy I (I, 3)** Development of an investigation into some problem of basic or applied physical therapy science. Case studies, preliminary data, or survey instruments are compiled, and a review of related literature is accomplished under guidance of faculty. *Pre: 515, third-year standing in physical therapy, or permission of instructor.* Staff

**528 Professional Practice and Administration (II, 3)** Responsibilities of the physical therapist in supervising personnel and establishing therapeutic practice in hospital, out-patient, and private settings. Department planning, personnel development,

cost accounting and billing, standards of practice, and quality assurance are discussed. (*Lec. 3*) *Pre: second-year standing in physical therapy or permission of instructor.* Roush

**532 Physical Agents and Instrumentation in Physical Therapy (II, 4)** Theory, clinical investigations, and current research regarding the application of physical therapeutic energies and agents. Direct treatment techniques and supervision of support personnel in the administration of mechano-, electro-, thermo-, hydro-, ionto-, and phototherapy. (*Lec. 3, Lab. 3*) *Pre: 420, second-semester standing in physical therapy or permission of instructor.* Rowinski

**535 Research Project in Physical Therapy II (II, 3)** Completion of investigation into some problem of basic or applied physical therapy science. Data gathering is completed, results are summarized, and conclusions relating findings to previous studies are formulated. *Pre: 525 or permission of instructor.* Staff

**538 Professional Problems and Public Relations (I, 2)** Current problems in professional practice including legislative, educational, and interdisciplinary topics. Issues relating to consumers of physical therapy services and methods of marketing the services of physical therapists are elaborated. (*Lec. 2*) *Pre: third-year standing in physical therapy or permission of instructor.* Staff

**540 Human Motor Development and Learning (I, 3)** Development and maturation of the human nervous system forms the basis for clinical considerations of developmental disabilities and motor learning. Theories of motor skill acquisition and therapeutic interventions for neuromuscular problems of the infant, child, adolescent, and adult. (*Lec. 2, Lab. 3*) *Pre: 410, 430, second-year standing in physical therapy, or permission of instructor.* Robinson

**542 Clinical Diagnosis (I, 2)** Modern medical and therapeutic diagnostic methods are presented to develop competencies in referral and evaluation of disorders. Medical and pharmacological science topics pertaining to physical therapy diagnoses are presented by invited lecturers. (*Lec. 2*) *Pre: second-year standing in physical therapy or permission of instructor.* Rowinski

**550 Orthopaedic Physical Therapy (I, 3)** Physical evaluation and treatment techniques of the human muscular, articular, and skeletal systems related to orthopaedic conditions. Rehabilitation of injured, congenitally dysfunctional, surgically intervened patients, and patients with conditions at risk for dysfunction. (*Lec. 2, Lab. 3*) *Pre: 410, 412, 420, 510; second-year standing in physical therapy or permission of instructor.* Blanpied

**552 Functional Rehabilitation and Advanced Therapeutic Exercise (II, 3)** Patient care techniques and programs related to the restoration of functional

motor activities are provided through specification of treatment protocols, assistive devices, therapeutic apparatus, and therapeutic exercise programs. Competency is developed by simulating actual clinical conditions. (*Lec. 2, Lab. 3*) *Pre: 550 or permission of instructor.* Blanpied and Agostinucci

**555 Seminar in Physical Therapy (I, II, or SS, 1–3)** Group exploration of advanced topics in physical therapy through study of recent literature and investigations. Detailed research reviews, clinical cases, and reports are brought to discussion. May be repeated with different topic for a maximum of 6 credits. (*Lec. 1–3*) *Pre: graduate standing and permission of instructor or chairperson.* Staff

**560 Neurological Physical Therapy (II, 3)** Physical therapy for the neurologically disabled patient. Proprioceptive neuromuscular facilitation, neurodevelopmental, sensory-motor integration, other patterned stimulation and evaluation techniques with emphasis on stroke, spinal cord injury, and other disabling conditions of the nervous system. (*Lec. 2, Lab. 3*) *Pre: 430, ZOO 242, second-year standing in physical therapy, or permission of instructor.* Robinson

**570 Cardiopulmonary Physical Therapy (II, 3)** Physiological basis, testing and evaluation, treatment, and administration of programs for cardiac and pulmonary-diseased patients requiring physical therapy. (*Lec. 2, Lab. 3*) *Pre: 420, 422, second-year standing in physical therapy, or permission of instructor.* Robinson

**574 Sports Physical Therapy (II, 2)** Advanced knowledge and competency in sports injury evaluation and treatment are developed. Additional coverage of sports injury prevention, athletic screening, medical intervention, interdisciplinary coordination, and patient or public education is provided. (*Lec. 1, Lab. 3*) *Pre: 550 or permission of instructor.* Blanpied

**575 Physical Therapy Internship I (SS, 5)** Assignment to various clinical settings which provide supervised experiences with practicing physical therapists and support personnel. Specific setting and rotational time schedule is determined by the academic clinical coordinator and clinical staff. *Pre: permission of instructor.* Staff

**580 Pediatric and Geriatric Physical Therapy (I, 3)** Specific problems of the maturing and aging patient population in physical therapy practice. Developmental disability programs and treatment programs in nursing facilities, treatment centers, and home programs for the aged patient population. (*Lec. 3*) *Pre: 430, 540, third-year standing in physical therapy.* Robinson

**585 Physical Therapy Internship II (II, 5)** Assignment to various clinical settings which provide supervised experiences with practicing physical therapists and support personnel. Specific setting and rotational time schedule is determined by the academic clinical coordinator and clinical staff. *Pre: permission of instructor.* Staff

**590 General Practice Physical Therapy** (I, 3) Problems and benefits associated with the business and conduct of different types of physical therapy private practice. Integration of the art and science of physical therapy with the delivery of services. (Lec. 3) *Pre: 418, 528, third-year standing in physical therapy.* Staff

**595 Physical Therapy Internship III** (II, 5) Assignment to various clinical settings which provide supervised experiences with practicing physical therapists and support personnel. Selection of clinical specialty area of student's interest is considered in determination of the setting. *Pre: permission of instructor.* Staff

## Physics

M.S., Ph.D.  
401-792-2633

### Graduate Faculty

*Chairperson:* Professor Surendra S. Malik, Ph.D., 1960, Agra University  
Professor Jill C. Bonner, D.Sc., 1984, King's College, University of London  
Professor J. Scott Desjardins, Ph.D., 1959, Columbia University  
Professor Kenneth L. Hartt, Ph.D., 1963, University of Nebraska  
Professor Leonard M. Kahn, Ph.D., 1976, Brown University  
Professor Charles Kaufman, Ph.D., 1963, Pennsylvania State University  
Professor Stephen V. Letcher, Ph.D., 1964, Brown University  
Professor Alexander E. Meyerovich, Ph.D., 1977, Institute of Physical Problems, Moscow  
Professor Gerhard Muller, Ph.D., 1980, University of Basel  
Professor M. Peter Nightingale, Ph.D., 1978, University of Amsterdam  
Professor Jan A. Northby, Ph.D., 1966, University of Minnesota  
Professor Anthony C. Nunes, Ph.D., 1969, Massachusetts Institute of Technology  
Professor Stanley J. Pickart, Ph.D., 1958, University of Maryland  
Professor Albert Steyerl, Ph.D., 1971, Technische Universitat, Munich  
Assistant Professor David R. Heskett, Ph.D., 1985, University of Pennsylvania  
Adjunct Professor Frank W. Cuomo, M.S., 1961, University of Rhode Island  
Adjunct Professor Louis Goodman, Ph.D., 1971, Drexel University  
Adjunct Professor Richard A. McCorkle, Ph.D., 1967, North Carolina State University  
Adjunct Assistant Professor Elizabeth Bozyan, Ph.D., 1985, University of Texas, Austin

### Specializations

*Acoustics and optics:* underwater acoustics; acoustic imaging; ultrasonics; acousto-optical transducers; fiber optics.

*Astronomy:* astrometry; differential photometry.

*Condensed matter theory:* low-dimensional physics; statistical mechanics; magnetism; surface magnetism; Fermi liquids, spin-polarized helium and hydrogen, nonlocal hydrodynamics; chemisorption; superconductivity; alloys; hydrogen in metals; defects in solids.

*Interdisciplinary physics:* computational physics; biophysics; magnetochemistry; dissipative chaos applied to marine and climate phenomena.

*Liquid state:* liquid crystals; liquid helium; ferrofluids turbulence; superfluids.

*Low-temperature physics:* ionic mobilities; finite droplet effects; magnetic susceptibility; specific heats; magnetic cooling; quantum solids, liquids, and gases.

*Neutron physics:* ultra-cold neutrons; neutron optics.

*Neutron scattering:* small-angle scattering; solution scattering; surfaces and fine particles; crystal structure; amorphous magnets; high-temperature superconductors; inelastic scattering; phonons and spin waves.

*Nuclear theory:* inverse scattering studies; few-nucleon studies; hypernuclei; weak interactions.

*Surface physics:* electronic and structural properties of surfaces including phase transitions using LEEDS, AUGER, X-rays, and BNL Synchrotron Facility.

### Master of Science

*Admission requirements:* GRE with advanced test recommended; bachelor's degree with major in physics preferred.

*Program requirements:* PHY 510, 520, 525, 530, 560, 570, and 580 are required of all students. For both the thesis and the non-thesis options, the student will complete 30 credits, of which no more than six may be below the 500 level. For the nonthesis option, at least one course will require a substantial paper involving significant independent study, and the student must pass a final written and oral examination.

### Doctor of Philosophy

*Admission requirements:* GRE with advanced test recommended; bachelor's degree with major in physics preferred. Master's degree is not required.

*Program requirements:* PHY 510, 520, 525, 530, 570, 580, 610, 625 (or 626), 630, 660, 670, and 680. There is no formal departmental language requirement, although the candidate's committee may require demonstration of language proficiency. Successful completion of a qualifying examination is required of all students.

### PHY Courses Physics

**401, 402 Seminar in Physics** (I and II, 1 each)

**410 Computational Physics** (II, 3)

**420 Introduction to Thermodynamics and Statistical Mechanics** (I, 3)

**425 Acoustics** (I, 3)

**451 Introduction to Quantum Mechanics** (I, 3)

**452 Quantum Mechanics: Techniques and Applications** (II, 3)

**455 Introduction to Solid-State Physics I** (I, 3)

**483, 484 (or AST 483, 484 or OCG 483, 484) Laboratory and Research Problems in Physics** (I and II, 3 each)

**491, 492 (or AST 491, 492) Special Problems** (I and II, 1-6 each)

**510 Mathematical Methods of Physics I** (I, 3) Topics designed to include applications in physics. Vector and tensor analysis; linear algebra; coordinate systems. Determinants, matrices; introductory group theory. Infinite series, complex analysis, analytic properties, conformal mapping, calculus of residues. Fourier analysis and Laplace transforms. (Lec. 3) *Pre: permission of chairperson.* Staff

**520 Classical Dynamics** (I, 3) Newton's laws. Conservation theorems and symmetry properties. Lagrangian mechanics. Central force motion. Dynamics of rigid bodies. Hamiltonian mechanics. Canonical transformations. Action-angle coordinates. Hamilton-Jacobi theory. Deterministic chaos. Relativistic mechanics. (Lec. 3) *Pre: credit or concurrent enrollment in 510.* Staff

**525 Statistical Physics I** (I, 3) Equilibrium thermodynamics (laws of thermodynamics, thermodynamic potentials). Phase transitions (phase coexistence, Clausius-Clapeyron equation, metastable states, critical point). Kinetic theory. Equilibrium statistical mechanics (microcanonical, canonical, grandcanonical ensembles, bosons, fermions). Critical phenomena. (Lec. 3) *Pre: 420 or equivalent, 510.* Staff

**530 Electromagnetism I** (II, 3) Electrostatics, including boundary value problem. Multipoles, electrostatics of macroscopic media, dielectrics. Magnetostatics. Time-varying fields, Maxwell equations, conservation laws. Plane electromagnetic waves, wave propagation. Wave guides, resonant cavities. Magnetic materials. (Lec. 3) *Pre: credit or concurrent enrollment in 510 and 520.* Staff

**560 Experimental Methods in Condensed Matter Science** (I or II, 3) Fundamental experiments on topics related to departmental research. Experimental methodology. (Lec. 3) *Pre: 484 or equivalent.* Staff

**570 Quantum Mechanics I** (II, 3) Dirac notation. Matrix representations, observables, uncertainty relations. Time evolution; Schroedinger and Heisenberg pictures. Schroedinger equation applications. Propa-

gators and Feynman path integrals. Aharonov-Bohm effect. Angular momentum; Wigner-Eckart theorem. *Pre: credit or concurrent enrollment in 510 and 520. Staff*

**580 Condensed Matter Physics I (I, 3)** Introductory theories. Crystal lattices (classification, reciprocal lattice, diffraction). Electron energy levels (periodic structures, tight-binding, APW, OPW approximations, pseudopotentials; Fermi surfaces). Phonons (harmonic and anharmonic effects). Dispersion. Electron-phonon interaction. (*Lec. 3*) *Pre: 530 or permission of chairperson. Staff*

**590 Faculty Project (I or II, 1–6)** A special project directly related to the research program of an individual faculty member. (*Lec. or Lab. according to nature of project*). *Pre: permission of chairperson. Not to exceed 6 credits. Staff*

**591 Special Problems (I and II, 1–6)** Advanced study under the supervision of a staff member arranged to suit the individual needs of the student. (*Lec. or Lab. according to nature of problem*) *Pre: permission of chairperson. Not to exceed 6 credits. Staff*

**599 Master's Thesis Research (I and II)** Number of credits is determined each semester in consultation with the major professor or program committee. *S/U credit.*

**610 Mathematical Methods of Physics II (II, 3)** Topics designed to include applications in physics. Ordinary and partial differential equations; Sturm-Liouville theory. Numerical methods and computational techniques. Probability and statistics. Integral transforms. Integral equations; Green's functions. Special functions of mathematical physics. (*Lec. 3*) *Pre: 510. Staff*

**625 Statistical Physics II (II, 3)** Equilibrium critical phenomena (critical exponents, scaling relations, multicritical phenomena). Exact solutions. Renormalization group theory and other approximate methods. Critical behavior of magnets, fluids, and surfaces. (*Lec. 3*) *Pre: 525 and 670. Staff*

**626 Statistical Physics III (II, 3)** Stochastic processes. Markov condition. Master equation. Fokker-Planck equation. Brownian motion. Langevin equation. Transport phenomena. Onsager theory of irreversible processes near equilibrium. Boltzmann equation. Linear response theory, fluctuation dissipation theorem. (*Lec. 3*) *Pre: 525. Muller*

**630 Electromagnetism II (I, 3)** Radiating systems, scattering, and diffraction. Special theory of relativity. Dynamics of relativistic particles and electromagnetic fields. Collisions between charged particles, energy loss and scattering. Radiation by moving charges. Multipole fields. (*Lec. 3*) *Pre: 530. Staff*

**660 Nuclear and Particle Physics (II, 3)** Weak, strong, and electromagnetic interactions. Nucleon-nucleon potential, shell model, optical model. Isospin, unitary sym-

metry, quark model of hadrons. Scattering and reaction theory of few-body systems. Deuteron. Relativistic nuclear and particle phenomena. (*Lec. 3*) *Pre: 570 and 670. Staff*

**670 Quantum Mechanics II (I, 3)** Symmetry (parity, translation, time-reversal). Time-independent (dependent) perturbation theory, variational methods. Identical particles. Scattering theory (Lippman-Schwinger equation, Born series, partial waves, resonances, optical theorem, inelastic scattering). Applications. Relativistic quantum mechanics. (*Lec. 3*) *Pre: 570 or permission of chairperson. Staff*

**672 Quantum Mechanics III (II, 3)** Atomic systems (structure, semiclassical radiation theory, collisions). Quantum fields (scalar, spin-1/2, electromagnetic). Applications: quantum field theory (Feynman diagrams in QED and weak interactions, renormalization). Fock space. Many-body theory. (*Lec. 3*) *Pre: 670. In alternate years. Next offered spring 1995. Staff*

**680 Condensed Matter Physics II (II, 3)** Interacting systems. Green's functions. Second quantization. Landau theory of quasi-particles. Schroedinger and Heisenberg pictures. Many-body Green's functions. Perturbation series, diagrammatic analysis. Dielectric response. Thermal properties. Phonons in metals. (*Lec. 3*) *Pre: 580. Staff*

**690 Topics in Physics (I or II, 3)** Advanced topics in areas of research specializations: a) neutron physics; b) quantum fluids; c) magnetism; d) surface physics; e) nonlinear phenomena; f) advanced quantum physics; g) nuclear physics; h) low-temperature physics. (*Lec. 3*) *Pre: permission of chairperson. Staff*

**691 Advanced Special Topics (I or II, 1–6)** Special topics related to current developments by visiting or permanent faculty. (*Lec. or Lab. according to nature of problem*) *Pre: permission of instructor. Staff*

**699 Doctoral Dissertation Research (I and II)** Number of credits is determined each semester in consultation with the major professor or program committee. *S/U credit.*

**930 Workshop in Physics Topics for Teachers (I, II, and SS, 0–3 each)** Especially designed for teachers of physical sciences. Basic topics in physics from an advanced or pedagogical perspective. (*Lec. or Lab.*) *Pre: teacher certification. Staff*

## AST Courses Astronomy

**483, 484 (or PHY 483, 484 or OCG 483, 484) Laboratory and Research Problems in Physics (I and II, 3 each)**  
**491, 492 (or PHY 491, 492) Special Problems (I and II, 1–6 each)**

## Plant Pathology

Ph.D. (Biological Sciences)  
401-792-2792

### Graduate Faculty

*Chairperson:* Professor Richard J. Hull, Ph.D., 1964, University of California  
Professor Noel Jackson, Ph.D., 1960, University of Durham  
Professor Walter C. Mueller, Ph.D., 1961, Cornell University  
Associate Professor Larry Englander, Ph.D., 1973, Oregon State University  
Professor Emeritus Carl H. Beckman, Ph.D., 1953, University of Wisconsin

### Specializations

*Plant pathology:* disease resistance mechanisms, fine structure of pathogen-host interactions, epidemiology of diseases infecting turfgrasses and woody ornamental plants. *Plant protection:* plant diseases, integrated pest management, plant-insect interactions, and plant-endophyte associations.

### Doctor of Philosophy (Biological Sciences)

Limited to plant pathology specializations.

*Admission requirements:* GRE and, preferably, a master's degree in botany or plant pathology; GRE and undergraduate major in biological, agricultural, or physical sciences. Fundamental courses in biological sciences, mathematics, and chemistry may be required to make up deficiencies without graduate credit.

*Program requirements:* course work as determined by graduate committee; dissertation. For courses, see listing under Plant Sciences.

## Plant Sciences

M.S., Ph.D. (Biological Sciences)  
401-792-2791

### Graduate Faculty

*Chairperson:* Professor Richard J. Hull, Ph.D., 1964, University of California  
Associate Professor Dale T. Duff, Ph.D., 1967, Michigan State University  
Associate Professor William R. Krul, Ph.D., 1967, Purdue University  
Associate Professor Richard J. Shaw, Ph.D., 1966, University of Missouri  
Associate Professor W. Michael Sullivan, Ph.D., 1981, University of Nebraska  
Assistant Professor Joel Chandlee, Ph.D., 1984, North Carolina State University  
Assistant Professor Brian K. Maynard, Ph.D., 1990, Cornell University  
Assistant Professor Bridget A. Ruemmele, Ph.D., 1989, University of Minnesota  
Adjunct Professor Raymond B. Taylorson, Ph.D., 1960, University of Wisconsin

Adjunct Assistant Professor Stephen L. Dellaporta, Ph.D., 1981, Worcester Polytechnic Institute

### Specializations

Turfgrasses, woody ornamentals, and agricultural crops. Program emphasis may be developed in plant-soil nutrient relations, plant propagation including tissue culture, stress physiology, crop improvement, plant molecular biology, and the ecology of crop production. Additional areas include landscape ecology and floriculture. Specializations in soil science are available in the natural resources program.

### Master of Science

**Admission requirements:** GRE, B.A. or B.S. degree with undergraduate courses in botany, agronomy or horticulture, chemistry, mathematics, physics, and soils passed with grades of A or B. Deficiencies in these areas must be corrected without graduate program credit. An area of interest corresponding to a field of program emphasis must be indicated. Applicants are encouraged to contact a faculty member in their area of interest who may be willing to serve as their major professor. Initial contact may be made with the chairperson of the Department of Plant Sciences.

**Program requirements:** thesis option—a thesis based on independent experimental research and 24 credits of course work, including PLS 501 and 502. Nonthesis option (with permission of the department at time of admission)—36 credits of course work with a minimum of 14 credits in plant science to include PLS 501 and 502 and at least one of the following: PLS 511, 512, 571, 572, or 576. Three credits in experimental statistics and a written project involving significant independent work (PLS 591 or 592) are also required. A written comprehensive examination administered by the student's major professor and two additional members of the faculty (at least one must be from the Department of Plant Sciences) is required after most courses have been taken.

### Doctor of Philosophy (Biological Sciences)

**Admission requirements:** GRE and, normally, an M.S. in an agricultural or biological science. Applicants who are admitted without an M.S. must pass a qualifying examination after earning 18–24 credits.

**Program requirements:** comprehensive exams in one major and two minor areas chosen from agronomy, horticulture, soil science, crop ecology, plant biochemistry, crop physiology, soil biology, anatomy-morphology, taxonomy-systematics, and genetics (one of the first three areas must be included). Demonstration of sufficient knowledge to teach an introductory plant science course and competence in one

research tool selected from experimental statistics, computer science, electron microscopy, and analytical chemistry. Substitution of a foreign language for the requirement of an additional research tool may be specified by the student's committee. Dissertation.

### PLS Courses Plant Sciences

- 401, 402 Plant Sciences Seminar** (I and II, 1 each)  
**405 Propagation of Plant Materials** (II, 3)  
**415 Theories and Practices in Therapeutic Horticulture** (II, 3)  
**436 Floriculture and Greenhouse Crop Production** (II, 4)  
**440 Diseases of Turfgrasses, Trees, and Ornamental Shrubs** (II, 3)  
**441 Plant Disease Laboratory** (I, 1)  
**442 Professional Turfgrass Management** (II, 3)  
**461 Weed Science** (I, 3)  
**463 Principles of Plant Disease Control** (II, 3)  
**471 Plant Improvement I** (I, 3)  
**472 Plant Improvement II** (II, 3)  
**475 (or NRS 475) Plant Nutrition and Soil Fertility** (II, 4)  
**491, 492 (or LAR 491, 492) Special Projects and Independent Study** (I and II, 1–3 each)

**501, 502 Graduate Seminar in Plant Sciences** (I and II, 1 each) Presentation of technical reports and discussion of current research papers in crop science, landscape ecology, growth and development of economic plants, and production, protection, and management of economic crops. (Lec. 1) *Pre: permission of instructor. Staff*

**511 The Nature of Plant Disease** (I, 3) Analysis of the nature of plant disease, the processes of infection and pathogenesis, and the structural and physiological responses that determine resistance to disease. (Lec. 3) *Pre: BOT 332 or equivalent. In alternate years. Next offered 1993–94. Staff*

**512 Plant Growth and Development** (II, 4) Environmental, chemical, and genetic regulation of plant development, from seed formation to senescence. (Lec. 3, Lab. 3) *Pre: BOT 245. In alternate years, next offered 1993–94. Krul*

**513 Laboratory Plant Tissue Culture** (II, 1) Techniques for initiation and continuous culture of plant cells; protoplast isolation, fusion, and selection; micropropagation, somatic embryogenesis, and production of haploid plants via pollen and anther culture. (Lab. 3) *Pre: BOT 245, concurrent enrollment in 472, and permission of instructor. In alternate years. Next offered 1993–94. Krul*

**572 (or BCP 572) Plant Biochemistry** (I, 3) Physiological chemistry unique to plants. Emphasis on energy acquiring, transferring, and storing reactions including the metabolism of carbohydrates, amino acids, lipids, phenolics, and phytohormones. (Lec. 3) *Pre: BCP 311 or 581 or permission. In alternate years. Next offered 1993–94. Hull*

**576 Physiology of Plant Productivity** (I, 3) Critical analysis of contemporary views on energy conversion and transformation in primary plant production. Topics include photosynthesis, phosphorylation, photorepiration, transport mechanisms, nitrogen assimilation, and symbiosis. (Lec. 3) *Pre: organic chemistry, plant physiology, biochemistry, or permission of instructor. In alternate years. Next offered 1994–95. Hull*

**591, 592 Nonthesis Research in Plant Sciences** (I and II, 1–3 each) Advanced work under the supervision of research staff to expand research experience into areas other than those related to thesis research. Arranged to suit individual requirements. (Lab. 3–9) *Pre: permission of instructor. Staff*

**599 Master's Thesis Research** (I and II) Number of credits is determined each semester in consultation with the major professor or program committee. *S/U credit.*

**699 Doctoral Dissertation Research** (I and II) Number of credits is determined each semester in consultation with the major professor or program committee. *S/U credit.*

*Note: For other related courses, see BOT 332, 432, 437, 453, 521, 524, 546, 554, MIC 552, and ZOO 581, 586.*

### Political Science

M.A., M.P.A.  
401-792-2183

#### Graduate Faculty

**Chairperson:** Professor Gerry R. Tyler, Ph.D., 1972, Yale University  
 Professor Timothy M. Hennessey, Ph.D., 1968, University of North Carolina  
 Professor Alfred G. Killilea, Ph.D., 1969, University of Chicago  
 Professor Edgar C. Leduc, Ph.D., 1963, Indiana University  
 Professor Lawrence Rothstein, Ph.D., 1976, University of Massachusetts  
 Professor Arthur Stein, Ph.D., 1965, University of Pennsylvania  
 Professor Norman L. Zucker, Ph.D., 1960, Rutgers—The State University  
 Associate Professor Cynthia M. Hamilton, Ph.D., 1980, Boston University  
 Assistant Professor Marc A. Genest, Ph.D., 1992, Georgetown University  
 Assistant Professor Maureen Moakley, Ph.D., 1984, Rutgers—The State University  
 Assistant Professor Nicolai N. Petro, Ph.D., 1984, University of Virginia  
 Adjunct Professor William E. Hudson, Ph.D., 1976, Brown University  
 Adjunct Professor Mark S. Hyde, Ph.D., 1972, Michigan State University  
 Adjunct Professor Victor L. Profughi, Ph.D., 1967, University of Pittsburgh  
 Adjunct Associate Professor Francis J. Leazes, Jr., Ph.D., 1984, University of Connecticut

### Master of Arts

*Specializations:* international relations, comparative politics, American politics, and public policy.

*Admission requirements:* GRE, GMAT, or MAT, and undergraduate credit in basic political science and political theory.

*Program requirements:* a minimum of 30 credits including PSC 553, 580, and 583 for both thesis and nonthesis options; non-thesis option requires one course including a substantial paper requiring significant independent research and an oral examination in addition to comprehensive examination.

### Master of Public Administration

The Rhode Island Master of Public Administration Program (RIMPA) leads to the M.P.A. degree conferred by the University of Rhode Island. It is a collaborative undertaking, governed and offered by a committee of university faculty that includes adjunct faculty from Rhode Island College and Providence College. The RIMPA is offered at URI's Providence Campus and provides federal, state, and city officials and agencies easy access to its instructional programs and research expertise. In addition to delivering its degree and certificate programs, internships, and workshops, the RIMPA faculty conducts research into the formation and implementation of public policy and the administration of public and nonprofit agencies. Current research areas include public professional ethics, the training of public managers, water resource management, the governance and financing of nonprofits, state prison administration, the public administration of technology, industrial policy at the state and national levels, and case management in mental health agencies.

*Admission requirements:* generally, GRE, MAT, or GMAT with 1000 score (verbal plus quantitative) and undergraduate credit in basic political science.

*Program requirements:* nonthesis—one course including a substantial paper requiring significant independent research; comprehensive examination; internship; minimum total of 36 credits including PSC 501, 502, 503, 505, 506, 524, and 573. Competency in computer science and statistics is required and may be demonstrated by completion of a basic course at the undergraduate level.

### Cooperative Program (M.P.A. and M.L.I.S.)

A cooperative program permits joint enrollment in the Master of Library and Information Studies and the Master of Public Administration programs. The integrated pursuit of the two degrees makes it possible for nine credits of appropriately selected course work from one program to serve as electives in the other, and for six

credits of such course work to be applied in the opposite direction. Thus, when planned and taken jointly, the two programs can be completed with a total of 63 credits.

*Admission requirements:* GRE and other requirements listed for M.L.I.S. and M.P.A. Applicant must apply and be accepted in both programs. Applications to both programs must indicate M.L.I.S./M.P.A. as the field of specialization.

*Program requirements:* Each student must complete the required core courses for both programs plus three credits of PSC 590 for the M.P.A. After consultation with, and approval of, both departments, students must file separate programs of study for each degree, indicating the courses to be jointly counted. Each student must pass the separate comprehensive examination for each degree. A student who fails to complete one of the programs may, of course, complete the other in accordance with the separate program of study.

### PSC Courses Political Science

#### 401 Comparative European Politics

(I and II, 3)

#### 402 Environmental Policy and Politics

(I, 3)

#### 405 The Indian Political System:

Tradition and Modernity (II, 3)

#### 407 The Soviet Union: Politics and

Society (II, 3)

#### 408 African Government and Politics

(I, 3)

#### 410 (or AAF 410) Issues in African

Development (I or II, 3)

#### 420 Nonviolence and Change in the

Nuclear Age (I, 3)

#### 422 Comparative American State Politics

(II, 3)

#### 431 International Relations (I, 3)

#### 432 International Government (II, 3)

#### 434 American Foreign Policy (II, 3)

#### 440 The Politics of Being Mortal (I or II, 3)

#### 443 Twentieth-Century Political Theory

(I, 3)

#### 455, 456 Directed Study or Research

(I and II, 3 each)

#### 461 The American Presidency (I, 3)

#### 464 International Law (II, 3)

#### 466 Urban Problems (II, 3)

#### 471 Constitutional Law (I, 3)

#### 472 Civil Liberties (II, 3)

#### 474 Criminal Justice Systems (II, 3)

#### 481, 482 Political Science Seminar

(I and II, 3 each)

#### 483 Political Process: Policy Formulation and Execution (I or II, 3)

#### 486 Cooperative Communities (II, 3)

#### 491 Principles of Public Administration

(I, 3)

#### 495 Comparative Urban Politics (I, 3)

#### 498 Public Administration and Policy

Formulation (II, 3)

#### 501 Administrative Theory (I or II, 3)

Theoretical constructs and models in fields of public administration; theories of Weber,

Riggs, Dorsey, Simon, Presthus. Lower-level models in subfields of organization, communications, and decision making. Task-oriented subject matter such as personnel, budget, and program administration related to theoretical formulations which seek to explain them. (Sem. 3) Pre: 491 or permission of instructor. Staff

#### 502 Techniques of Public Management

(I or II, 3) Principles and techniques employed in the administration of staff activities of the public service, such as administrative planning, project scheduling, and budgeting. (Sem. 3) Pre: 491 or permission of instructor. Staff

**503 Problems in Public Personnel Administration (I or II, 3)** Development of personnel administration, including problems of recruitment, examination, promotion, and staffing within public service. Emphasis on evaluation of employee performance and collective bargaining in public service. (Sem. 3) Pre: graduate standing or permission of instructor. Staff

**505 (or SOC 505) Public Program Evaluation (I or II, 3)** Research design and methodologies associated with the evaluation of governmental programs and activities. (Sem. 3) Pre: EST 308 or equivalent or permission of instructor. Staff

#### 506 Seminar in Budgetary Politics (I, 3)

Examination of federal, state, and local fiscal and budgetary processes, focusing on the politics of the budgetary process and models of budgeting, with emphasis on contemporary issues. (Sem. 3) Staff

#### 512 Seminar in Marine Science Policy and Public Law

See Marine Affairs 512.

#### 521 International and Comparative Trade Unions and Labor Relations

See Labor Studies 521.

#### 522 Issues in Corrections

See Sociology 522.

#### 523 Seminar in Comparative Public

Administration (I or II, 3) Theory, practice, and organization of selected European and developing nations' administrative systems. Analysis of selected policies. Influence of English and French systems on developing systems. Structure-function and ecological analysis. (Sem. 3) Pre: 491, 501, or permission of instructor. Staff

#### 524 Seminar in Public Policy Problems

(I or II, 3) In-depth exploration of selected problems of policy formulation—inter-governmental relations, regionalization, citizen participation and control, priority setting for public sector programs. (Sem. 3) Pre: 491, 501, or permission of instructor. Staff

#### 531 Behavior Systems in Crime

See Sociology 521.

#### 544 Democracy and Its Critics (I or II, 3)

Seminar examining the roots of modern democracy in the social contract theories and analyzing the quality and limits of self-determination in these theories in the light

of contemporary politics. (Sem. 3) Pre: 341, 342, or permission of instructor. Killilea

**546 Peace and World Order Studies (II, 3)** This seminar explores various approaches globally to peacebuilding, world order, and community. Emphasizes conflict resolution, from local to transnational levels, and the search for social justice and human unity. (Sem.) Pre: 420 or permission of instructor. Stein

**553 Scope and Methods of Political Science (I, 3)** Study of political science as a discipline, its development in relation to other social sciences, and survey of political theories, concepts, and analytic models. (Sem.) Pre: graduate standing. Leduc

**555, 556 Directed Study or Research (I or II, 3 each)** Special work arranged to meet the individual needs of graduate students in political science. (Sem. 3) Pre: permission of chairperson. Staff

**568 Jurisprudence (II, 3)** Introduction to the philosophy of law, treating the sources, the nature, and the consequences of major systems of legal thought. Emphasis on the relationship between legal reasoning and judicial decision making in the United States. (Sem. 3) Pre: 471, 472, or permission of instructor. Staff

**573 Administrative Law (I or II, 3)** Legal aspects of interaction between government agencies, individuals, and public interest groups. Systematic analysis of leading cases, evaluating the courts as an instrument for protecting the individual's rights in administrative action. (Sem. 3) Pre: 113. Rothstein

**577 International Ocean Law**  
See Marine Affairs 577.

**580 Seminar in International Relations Theory (I or II, 3)** A critical treatment of major international relations theories beginning with an analysis of core theoretical concepts. (Sem.) Pre: honors seniors with permission of instructor or graduate standing. Genest or Petro

**581, 582 Special Topics Seminar (I, II, or SS, 3)** Master's-level seminar on special topics in political science not regularly covered in other courses. Content indicated by descriptive title following colon. May be repeated up to five times for a total of 15 credits with different topic. (Sem.) Pre: graduate or senior standing in political science or permission of instructor. Staff

**583 Seminar in American Politics (I or II, 3)** Critical consideration of central issues in American political institutions, behavior, and policymaking. (Sem.) Pre: honors seniors with permission of instructor or graduate standing. Zucker or Moakley

**590 Internship in Public Administration (I or II, 3-6)** Participation at an administrative agency under supervision of agency head and a faculty member. Planning, personnel management, research organization, budgeting, interdepartmental relations, informal liaisons that are the hallmark of

effective administration. Pre: permission of M.P.A. director. May be taken as one 6-credit unit or two 3-credit units. Staff

**595 Problems of Modernization in Developing Nations**  
See Resource Economics 595.

**599 Master's Thesis Research (I and II)** Number of credits is determined each semester in consultation with the major professor or program committee. S/U credit.

## Psychology

M.S., Ph.D.  
401-792-2193

### Graduate Faculty

*Chairperson:* Professor Janet Kulberg, Ph.D., 1967, George Peabody College, Vanderbilt University  
Professor Allan Berman, Ph.D., 1968, Louisiana State University  
Professor Henry B. Biller, Ph.D., 1967, Duke University  
Professor Jerry L. Cohen, Ph.D., 1973, University of Illinois  
Professor Charles E. Collyer, Ph.D., 1976, Princeton University  
Professor David Faust, Ph.D., 1979, Ohio University  
Professor Paul R. Florin, Ph.D., 1981, George Peabody College, Vanderbilt University  
Professor Lawrence C. Grebstein, Ph.D., 1964, University of Kentucky  
Professor Ira Gross, Ph.D., 1967, University of Illinois  
Professor Albert J. Lott, Ph.D., 1958, University of Colorado  
Professor Bernice Lott, Ph.D., 1954, University of California, Los Angeles  
Professor James O. Prochaska, Ph.D., 1969, Wayne State University  
Professor Kathryn Quina, Ph.D., 1973, University of Georgia  
Professor Albert Silverstein, Ph.D., 1963, University of California, Berkeley  
Professor Nelson F. Smith, Ph.D., 1963, Princeton University  
Professor John F. Stevenson, Ph.D., 1974, University of Michigan  
Professor Dominic Valentino, Ph.D., 1971, University of California, Riverside  
Professor Wayne F. Velicer, Ph.D., 1972, Purdue University  
Professor Alan Willoughby, Ph.D., 1959, University of Connecticut  
Associate Professor Susan A. Brady, Ph.D., 1975, University of Connecticut  
Associate Professor Lisa Lavoie Harlow, Ph.D., 1985, University of California, Los Angeles  
Associate Professor Patricia J. Morokoff, Ph.D., 1980, State University of New York, Stony Brook  
Research Associate Professor Joseph S. Rossi, Ph.D., 1984, University of Rhode Island

Associate Professor W. Grant Willis, Ph.D., 1984, University of Georgia  
Assistant Professor Sarah Allen, Ph.D., 1991, University of Nebraska  
Assistant Professor Laurie Ruggerio, Ph.D., 1988, Louisiana State University  
Adjunct Professor David Abrams, Ph.D., 1981, Brown University  
Adjunct Professor John J. Colby, Ph.D., 1974, University of Rhode Island  
Adjunct Associate Professor Douglas Bernon, Ph.D., 1982, American University; Ph.D., 1987, California School of Professional Psychology  
Adjunct Associate Professor Gerald Groden, Ph.D., 1963, Purdue University  
Adjunct Associate Professor J. Eugene Knott, Ph.D., 1975, University of Maryland  
Adjunct Associate Professor Roger Mitchell, Ph.D., 1980, University of Maryland  
Adjunct Associate Professor Peter Monti, Ph.D., 1974, University of Rhode Island  
Adjunct Assistant Professor Stephen L. Buka, Sc.D., 1988, Harvard School of Public Health  
Adjunct Assistant Professor Denise DeZolt, Ph.D., 1992, Kent State University  
Adjunct Assistant Professor Bette LaSere Erickson, Ed.D., 1976, University of Massachusetts  
Adjunct Assistant Professor Joseph Fava, Ph.D., 1990, University of Rhode Island  
Adjunct Assistant Professor E. Grace Frenzel, Ph.D., 1979, Colorado State University  
Adjunct Assistant Professor Diane J. Goodman, Ed.D., 1989, University of Massachusetts  
Adjunct Assistant Professor June Groden, M.A., 1980, Boston College  
Adjunct Assistant Professor Thomas J. Guilmette, Ph.D., 1982, University of Missouri  
Adjunct Assistant Professor Katherine C. Haspel, Ph.D., 1981, University of Rhode Island  
Adjunct Assistant Professor Robert LaForge, Sc.D., 1987, Johns Hopkins University  
Adjunct Assistant Professor Judith Lubiner, Ph.D., 1989, University of Rhode Island  
Adjunct Assistant Professor Joseph A. Maxwell, Ph.D., 1986, University of Chicago  
Adjunct Assistant Professor Barry Plummer, Ph.D., 1981, University of Rhode Island  
Professor Emeritus Peter F. Merenda, Ph.D., 1957, University of Wisconsin  
Professor Emeritus William T. Vosburgh, Ph.D., 1965, Syracuse University

### Specializations

Programs are offered in clinical, experimental, and school psychology. Specializations are offered within each program. The clinical program encourages students to organize their courses so as to foster their developing career needs. Thus, one is encouraged to develop specific interests and competencies in areas such as family sys-

tems, substance abuse, child/clinical, community, neuropsychology, individual intervention, and general clinical practices. Students in the experimental program tend to concentrate in one of the following five areas: 1) human perception and learning; 2) conditioning and behavior change; 3) psychophysiology; 4) methodology and quantitative psychology; and 5) personality/social/community bases of behavior. Additional individual specialties can be developed within each of the program areas.

#### Master of Science (School Psychology Only)

**Admission requirements:** GRE, advanced test recommended. Undergraduate major in psychology recommended. Applicants are admitted for September only. The completed application package must be received by February 15.

**Program requirements:** nonthesis—internship; total of 60 credits with a minimum of 30 for the master's degree plus additional credits for certification as a school psychologist; one course with a major paper involving significant independent research; and a written comprehensive examination.

#### Doctor of Philosophy (Clinical, Experimental, and School Psychology)

**Admission requirements:** GRE, advanced test recommended; evidence of research competency. Applicants are admitted for September only. The completed application package must be received by January 20 for clinical, by February 15 for school, and by March 15 for experimental. Prospective applicants are asked to address initial inquiries concerning the desired specialization to the department. The formal application materials can be obtained from the Graduate School Office, but the completed application package must be sent to the department. Applicants to the clinical program are evaluated on the basis of previous academic achievement, GRE scores, previous life experience, previous applied clinical and research experience, letters of recommendation, personal interview, and projected balance between applicant and program needs.

Due to limited facilities, new admissions to the doctoral programs must be limited to a small number per year. Finalists in the school and clinical specialization must participate in a personal interview to complete the evaluation process. Although test scores and cumulative averages are not the sole criteria for admission for the clinical program, those with overall quality point averages of less than 3.00 (on a 4.00 scale), or whose verbal and quantitative GRE scores do not total above 1200, are advised that there is little chance for admission.

**Program requirements:** completion of a minimum of 90 credits (72 plus 18 for

dissertation). Language requirement optional depending on requirements set forth by the student's program committee. Research course requirements—a minimum of two courses in statistics (PSY 510/532) and a research methods course (PSY 611). The research competency requirement may be met by successfully defending a master's thesis or by successfully completing a research competency project under the direction of the major professor. The research competency project option is limited to those who have nonthesis master's degrees in psychology. Students who successfully complete the thesis option will earn a Master of Arts degree in psychology. A Ph.D. qualifying examination is required of all doctoral students entering without the master's degree. This requirement is met by completing four core courses from PSY 532, 533, 611, and those numbered 601–609, with a grade of B or better. These courses are usually completed prior to earning 24–30 credits. For students in the applied areas (clinical and school), at least one core course must be completed in each of the following content areas of psychology: biological bases of behavior; cognitive and affective bases; social bases; individual differences; and history and systems of psychology.

The objective of our Ph.D. program is to give our students the knowledge and skills they will need to be effective psychologists in their chosen area. Scientific training and research experience as well as knowledge and technical skills are a part of each student's program, but his or her program is individually designed around his or her needs and goals.

Both the clinical and the school psychology programs are accredited by the American Psychological Association. Both programs subscribe to the scientist-practitioner model, and thus course requirements are consistent with maintaining such accreditation. Practicum and individual research projects can be specifically tailored to help the student prepare for the professional role of his or her choice. These programs also have a strong experiential base, including field activity in each year. Students are expected to be involved in research for a substantial portion of their program.

The department emphasizes a close working relationship between faculty and students. No single theoretical or philosophical model is espoused.

#### PSY Courses Psychology

**405 (or APG 405) Psychological Anthropology** (I or II, 3)

**432 Advanced Developmental Psychology** (II, 3)

**434 Psychological Testing** (I or II, 3)

**436 (or PCL 436) Psychotropic Drugs and Therapy** (II, 3)

**442 The Exceptional Individual** (I and II, 3)

**456 Research Methods in Social Psychology** (II, 4)

**460 The Substance-Troubled Person** (I, II, and SS, 3)

**464 Humanistic Psychology** (II, 3)

**465 Introduction to Crisis Intervention** (I or II, 3)

**470 Topics in Social Psychology** (I, 3)

**471 Applied Behavioral Analysis and Remediation** (II, 3)

**473 Practicum in Behavioral Psychology** (I or II, 3)

**479 Contemporary Problems for Modern Psychology** (I and II, 3–12)

**480 The Female Experience** (II, 3)

**489 Problems in Psychology** (I and II, 3)

**499 Psychology Practicum** (I and II, 1–6)

**505 Community Psychology** (I, 3) Introduction to community psychology; study and change of individual's interaction with community systems; theoretical and empirical models, intervention strategies, and research methods relevant to community psychology. (Lec. 3) *Pre: permission of chairperson.* Florin

**517 (or EST 517) Small N Designs** (II, 3) A survey of Small N experimental methodology, including hypothesis of quasi-experimental designs and the application of interrupted time series. Applications in applied research, particularly behavioral intervention. (Lec. 3) *Pre: 532 and 533. In alternate years.* Velicer

**520 Mental Measurement and Test Theory** (I or II, 3) Study of statistical and theoretical background relevant to mental test scores. Principles of test construction. Controversies and current developments in measurement and psychometrics. (Lec. 3) *Pre: 434.* Harlow and Staff

**522 Behavioral Assessment Techniques** (II, 3) Interview, observational, questionnaire, self-monitoring, cognitive behavior modification, and analogue assessment procedures are reviewed in terms of their use and interpretation of behavior in clinical, institutional, home, and school settings. *Pre: 434 and 550. Offered in odd-numbered years.* Staff

**532 Experimental Design**  
See Experimental Statistics 532.

**533 Advanced Quantitative Methods in Psychology** (II, 3) Advanced quantitative methods applied to psychology. Survey of methods such as multiple regression, multivariate analysis of variance, discriminate analysis, canonical correlation, principal component analysis, and factor analysis. Applications involve BMDP, SAS, or SSPS computer programs. (Lec. 3) *Pre: 532.* Velicer or Harlow

**534 Structured Personality Assessment** (II, 3) Review of reliability, validation, and instrument construction methods for personality assessment. Critical evaluation of established (MMPI, Edwards, PRF) and re-

cent tests. Development and interpretation of individualized evaluations based on profile analysis. (Lec. 3) Pre: 434 or equivalent. Velicer and Staff

**540 (or EDC 540) Learning Disabilities: Assessment and Intervention (SS, 3)** Applications of early screening batteries; remedial programs for various disabilities, developing treatment exercises, behavioral programs, and programs for older children and adolescents. Emphasis on pragmatic application of skills for detection and treatment. (Lec. 3) Pre: permission of instructor. May be repeated as A and B for a maximum of 6 credits. Berman

**544 The Psychological Bases for Reading Disorders (I or II, 3)** An in-depth review of research on factors related to reading ability. Topics include linguistic requirements, perceptual and neurological factors, implications for screening and instruction. (Lec. 3) Pre: graduate standing or permission of instructor. Brady

**550 Operant Analysis of Behavior (I or II, 3)** Introduction to the principles of operant conditioning with emphasis on the use of these principles in the analysis of behavior. (Lec. 3) Smith

**554 Alternate Therapies (I or II, 3)** Theory and practice of those individual and group techniques which can be integrated into one's present style of helping: a) existential, b) body therapies, c) cognitive therapies, and d) other contemporary approaches. Students may participate in a maximum of five distinct workshops. (Lec. 2, Lab. 2) Pre: professional and/or graduate standing and permission of the coordinator. Staff

**599 Master's Thesis Research (I and II)** Number of credits is determined each semester in consultation with the major professor or program committee. S/U credit.

**601 Physiological Psychology (II, 3)** An advanced consideration of physiological research on neural, endocrine, and response systems as they relate to attention, motivation, emotion, memory, and psychological disorders. (Lec. 3) Valentino

**602 Learning and Motivation (II, 3)** Empirical and theoretical analysis of the basic principles of acquisition and loss of habits. Topically organized to deal with respondent and operant conditioning, and their relationship to reinforcement and motivation. (Lec. 3) Pre: undergraduate learning course. Silverstein and Staff

**603 Development (II, 3)** Theoretical, methodological, and applied issues in lifespan development, including cognitive, perceptual, psychomotor, affective, and social development. Topically organized. (Lec. 3) Kulberg, Biller, and Staff

**604 Cognitive Psychology (I, 3)** A survey of the theoretical and methodological issues in human cognition. Topics include pattern recognition, attention, memory, language, problem solving. (Lec. 3) Brady and Staff

**605 Personality (I or II, 3)** Reading of primary source materials from major personality theorists relevant to a particular topical emphasis. Application and comparative evaluation of the theories studied. (Lec. 3) Stevenson and Staff

**606 Social Psychology (I, 3)** Intensive exploration of the methods, theory, and database of contemporary social psychology focusing on salient issues that clarify significant topics in this area. (Lec. 3) A. Lott and Staff

**607 Advanced Psychopathology (I or II, 3)** Empirical literature with regard to etiological factors involved in the formation of pathological character trends and deviations. Evaluation of clinical theory and classification systems as related to the psychotherapeutic process. (Lec. 3) Grebstein and Staff

**608 Theories and Systems (I, 3)** An in-depth analysis of the origin and logical structure of major systematic approaches to psychology. Emphasis on significant recurrent controversies. (Lec. 3) Pre: graduate standing. Collyer or Silverstein

**609 Perception (I or II, 3)** A survey of topics in the psychology of perception, including sensory function; psychophysical models, measurement, and scaling; visual perception; and methods for analyzing perceptually guided behavior. (Lec. 3) Collyer

**610 (or EST 610) Parsimony Methods (I, 3)** Multivariate procedures designed to reduce the dimensionality and help in the interpretation of complex data sets. Methods include principal components analysis, common factor analysis, and image analysis. Related methods: cluster analysis and multidimensional scaling. Applications involve the use of existing computer programs. (Lec. 3) Pre: 533 or EST 541 or equivalent. In alternate years. Next offered 1994-95. Velicer

**611 Methods of Psychological Research and Experimental Design (I, 3)** Provides the student of psychology with a knowledge of research methodology and the techniques of experimental designs. It prepares for the development of thesis problems of graduate students in psychology and related disciplines. (Lec. 3) Pre: 532 and 533. Staff

**612 (or EST 612) Structural Modeling (II, 3)** Theory and methodology of path analysis with latent variables. Discussion of "causation" and correlation, Confirmatory Factor Analysis, Measurement and Structural Equation models. Practical applications utilizing LISREL, EQS, and PLS computer programs. (Lec. 3) Pre: 533 or 610. Harlow and Velicer

**615 Collaborative Research in Psychology (I or II, 0-3)** Collaborative approaches to psychological research. Special emphasis on topics that can involve students at varying levels of research skill. Format includes weekly topical seminar and biweekly colloquium combining all topical interest

groups. (Sem. 3, Colloquium 1) Pre: 300, 301, 532, or equivalent and permission. May be repeated for a maximum of 6 credits. S/U credit. Kulberg and Staff

**625 Seminar: Social Psychology (II, 3)** Emphasis on a major area in contemporary social psychology. Empirical studies analyzed for their relevance to theoretical and applied issues; students will design an original investigation. (Sem. 3) Pre: graduate standing or permission of instructor. May be repeated for a maximum of 6 credits with different topic. A. Lott, B. Lott, J. Cohen, and J. Stevenson

**641 Introduction to Psychotherapy (I, 3)** A transtheoretical analysis of the major systems of psychotherapy. Developing an integrative, eclectic model through identifying the processes of change that are the core of effective therapy. (Lec. 3) Staff

**644 Family Therapy (I, 3)** Introduction to theories and techniques of family assessment and family therapy. Seminar format with videotape illustrations, case presentation and discussion, role playing, lecture, and selected experiential exercises. (Lec. 3) Pre: permission of instructor. Grebstein

**645 Marital and Sexual Therapy (I, 3)** Behavioral, psychodynamic, and systems perspective on marital and sexual problems and treatments. Theory and research applied in supervised practice with troubled couples. (Lec. 3) Staff

**646 Group Therapy (I, 3)** Theory, research, and change strategies developed in working with small groups. Current research, models, and techniques will be discussed in the context of actual clinical work with groups. (Lec. 3) Pre: permission of instructor. In alternate years. Grebstein

**647 Child Therapy (I, 3)** Seminar discusses issues, techniques, and research related to behavior changes in children and their families. Aspects of therapy, the role of behavioral approaches, and the participation of parents will be explored. Direct, supervised experience is included in this course. (Lec. 3) Pre: participation in the Psychological Consultation Center. Staff

**661 Psychological Services I: Administration and Interpretation of Cognitive Tests (I, 3)** Instruction and practice in administration and interpretation of cognitive tests; individual intelligence tests of both general and specific abilities. Rationale, research evidence, clinical application of Stanford-Binet, Wechsler, McCarty scales. (Lec. 3) Berman and Willis

**662 Psychological Services II: Administration and Interpretation of Personality Tests (II, 3)** Instruction and practice in the administration and interpretation of instruments used in the assessment of personality. Emphasis on projective tests such as Rorschach, TAT. Rationale, research evidence, and clinical application. (Lec. 3) Berman and Staff

**664 Advanced Diagnostic Problems (II, 3)** Use and interpretation of cognitive, projective, and neural psychological tests. Focus on integrating data into meaningful description of total personality functioning. Use of the diagnostic interview. (Lec. 3) Pre: 661, 662, and permission of instructor. In alternate years. Berman

**665 Child Psychopathology (II, 3)** Issues in the classification of disordered behavior will be related to diagnostic and treatment considerations from early childhood through adolescence. Emphasis will be placed upon synthesizing knowledge about the psychological, developmental, and educational factors which affect disordered child behavior. (Lec. 3) Pre: 660. In alternate years. Next offered 1993-94. Berman

**666 Seminar: Ethical and Legal Issues in Psychology (I or II, 3)** Ethical, legal, and professional issues as they relate to the provision of psychological services and psychological research. Emphasis is on the study of ethical issues and the examination of the development of professional standards as they relate to the areas of clinical psychology practice, school psychology practice, and applied research practice. (Sem. 3) Mitchell and Staff

**668 School Psychological Consultation (II, 3)** Historical and contemporary perspectives on consultation are discussed in terms of mental health and psychoeducational services. The focus is on the content and process of consultation in various clinical and educational settings. (Sem. 3) Pre: 666 or equivalent. Staff

**670 Field Experience in Psychological Services (I and II, 1-12)** Training placements and internships are available in a variety of institutional agencies and school settings under supervision which must be acceptable to the department: (a) school, (b) experimental areas, (c) clinical. Pre: permission of chairperson. S/U credit. Staff

**672 Individual Clinical Practicum (I or II, 3-9)** Introductory experience in dealing with clinical problems in a variety of clinical settings. Individual supervision to be arranged. (Lec. 3) Pre: 661, 662. May be repeated for a maximum of 9 credits. S/U credit. Staff

**673 Seminar: Introduction to Clinical Psychotherapy (I, 3)** Theories and techniques of psychotherapeutic procedures involving directive and nondirective and play therapies. Theoretical rationale and empirical research with special emphasis on the child area. (Lec. 3) Staff

**674 Clinical Practices: Therapy (I or II, 1-12)** Specialized techniques of clinical interviewing, counseling, and psychotherapy. Critical discussions of student's own supervised therapy sessions: a) individual, b) behavior, c) sensitivity, d) specialized techniques. Pre: 640, 660, 673. May be repeated for a maximum of 12 credits. Staff

**676 Neurological Correlates of Psychopathology (II, 3)** Functioning and physiology of the central nervous system with particular attention to determining how neurological disruption and injury are manifested in behavioral disorder. Techniques used to evaluate and interpret neuropsychological functioning. (Lec. 3) Pre: permission of instructor. In alternate years. Next offered 1993-94. Berman

**680 School Practices I: Diagnostic (I and II, 3-9)** Testing procedures and devices in the diagnosis of organicity, personality problems, special learning problems, visual, auditory, and memory problems; includes administration, interpretation, and special adaptation of tests in the school situation. (Lec. 3) Pre: 434, 661. May be repeated for a maximum of 9 credits. Staff

**681 Special Problems in School Psychology (I or II, 3-9)** Role of the psychologist in the school setting. Several theoretical and practical issues concerned with the value of psychological theory, administrative philosophy, and school organization are explored. (Lec. 3) Pre: 680. May be repeated for a maximum of 9 credits. Vosburgh and Staff

**683 Psychology of the Exceptional Child (I, 3)** Social, psychological, and educational factors that constitute the matrix of concerns with the exceptional individual in the school and community. Recent innovations in public and private education and habilitation. Research issues and legislation discussed evolve into student studies. (Lec. 3) Gross

**687 Seminar: Topics in the Psychology of the Exceptional Individual (I or II, 3)** Survey of topics and current issues in the treatment, needs, and understanding of the psychology of specific exceptionalities. Pre: 683. May be repeated for a maximum of 9 credits with different topics. Staff

**690 Seminar: Contemporary Issues in Psychology (I and II, 3-12)** Recent developments and current issues. Rigorous exploration of experimental and theoretical literature. Study limited each semester to one of the following areas: developmental, clinical, motivation, perception, psychophysics, and scaling problem solving and thinking. (Lec. 3) May be repeated for a maximum of 12 credits. Staff

**692, 693 Directed Readings and Research Problems (I or II, 3-6 each)** Directed readings and advanced research work under the supervision of a staff member arranged to suit the individual requirements of the students. Staff

**694 Special Problems in Clinical Psychology (I or II, 3-12)** Instruction and clinical practicum training in unique problem areas of clinical psychology. Development of specialized evaluation instruments and procedures. (Lec. 3) May be repeated for a maximum of 12 credits. Staff

**695 Seminar: Teaching Psychology (II, 3)** Primarily a seminar in the teaching of psychology at the undergraduate level. Includes a consideration of general issues in college teaching, preparation of a course proposal, and sample presentation. (Lec. 3) Quina, Stevenson, and Staff

**696 Practicum: Teaching Psychology (I or II, 3)** Practicum for students teaching a college-level psychology course. Supervision of course preparation, presentation, and evaluation. Individual supervision to be arranged. (Lec. 3) Pre: 695. S/U credit. Staff

**699 Doctoral Dissertation Research (I and II)** Number of credits is determined each semester in consultation with the major professor or program committee. S/U credit. Staff

## Resource Economics

M.S.

401-792-2471

### Graduate Faculty

*Chairperson:* Professor Thomas F. Weaver, Ph.D., 1966, Cornell University  
*Director of Graduate Studies:* Professor James J. Opaluch, Ph.D., 1979, University of California, Berkeley  
 Professor John M. Gates, Ph.D., 1969, University of California  
 Professor Thomas A. Grigalunas, Ph.D., 1972, University of Maryland  
 Professor Jon G. Sutinen, Ph.D., 1973, University of Washington  
 Associate Professor James L. Anderson, Ph.D., 1983, University of California, Davis  
 Associate Professor Timothy J. Tyrrell, Ph.D., 1978, Cornell University  
 Associate Professor Dennis G. Wichelns, Ph.D., 1986, University of California, Davis  
 Assistant Professor Stephen K. Swallow, Ph.D., 1988, Duke University  
 Assistant Professor Cathy Wessells, Ph.D., 1989, University of California, Davis

### Specializations

Environmental economics, commercial fisheries management, international fisheries development, fisheries marketing and trade, fisheries business economics, coastal zone land use and management, quality of the marine environment, aquaculture economics, offshore oil and gas management, and natural resource pricing policies.

### Master of Science

*Admission requirements:* GRE; a strong undergraduate record in economics or business is highly desirable.

*Program requirements:* thesis option—24 credits including REN 534, a written comprehensive examination, and thesis. Nonthesis option—34 credits including

REN 534, a written comprehensive examination, and REN 598, with a substantial paper requiring significant independent research.

### Economics—Marine Resources (Interdepartmental) Ph.D.

401-792-2471

This interdepartmental program offers study in the economics of marine resources. It is administered by the Department of Resource Economics, with advice by graduate advisory faculty from several disciplines.

#### Graduate Faculty

*Resource Economics:* Professor Weaver, chairperson. Professors Gates, Grigalunas, Opaluch, and Sutinen; Associate Professors J. Anderson, Tyrrell, and Wichelns; Assistant Professors Swallow and Wessells.

*Economics:* Associate Professors Mead, Lardaro, and Suzawa.

*College of Business Administration:* Professors Comerford, Della Bitta, Jarrett, and Mojena; Associate Professors Dash, N. Dholakia, and Lord.

#### Specializations (Ph.D.)

Environmental economics, commercial fisheries management and marketing, international fisheries development, coastal zone land use and management, quality of the marine environment, aquacultural economics, offshore oil and gas management, and natural resource pricing.

*Admission requirements:* GRE, 6 credits in statistics, and the following courses or their equivalents—ECN 327, 328, and 375.

*Program requirements:* the Ph.D. qualifying examination is required of students admitted without the master's degree. ECN 527, 576, 628; REN 534, 602, 630, 634, 635, and 676. Additional courses may be elected from appropriate offerings in economics, resource economics, engineering, geography, oceanography, mathematics, political science, statistics, computer science, and management science. The dissertation will be written on a problem involving marine resources or an associated industry, such as minerals, petroleum, fisheries, water, transportation, recreation, or waste disposal.

### REN Courses Resource Economics

- 410 Economics of Natural Resource Use (II, 3)
- 432 Economics of Land and Water Resources (II, 3)
- 435 Aquacultural Economics (I, 4)
- 440 Benefit-Cost Analysis (II, 3)
- 456 Tourism Economics (II, 3)
- 460 Economics of Ocean Management (II, 3)

### 491, 492 Special Projects (I and II, 1–3 each)

**514 Economics of Marine Resources (I, 3)** Role of economics in development of marine resources. Particular attention to problems of multiple use of resources and to the conflicts between private and public goals. (Lec. 3) *Pre: enrollment in the M.M.A. program or permission of instructor. Not for graduate credit in resource economics.* Grigalunas

**520 Production Economics (I, 2)** Production in natural resource economics. The formulation and estimation of production functions. Technological change in economic growth and its measures. New directions in production theory and applications. (Lec. 2) *Pre: ECN 528 or permission of instructor.* Staff

**522 Mathematical Programming for Natural Resource Management (I, 2)** Application of mathematical (linear) programming to typical natural resource management issues. Emphasis is placed on problem formulation and solution using existing computer software programs. (Lec. 2) *Pre: 528 or permission of instructor.* Gates

**524 Dynamic Economic Models (I, 3)** Fundamentals of dynamic economic theory and nonlinear models. Dynamic and nonlinear optimization techniques applied to resource economics, decision analysis, and trade models. (Lec. 3) *Pre: 528 or permission of instructor.* Anderson

**527 Macroeconomic Theory**  
See Economics 527.

**528 Microeconomic Theory**  
See Economics 528.

**532 Land Resource Economics**  
See Community Planning 537.

**534 Economics of Natural Resources (II, 3)** Microeconomic theory applied to problems of natural resource allocation. The rationale for government intervention in the market's provision of natural resources and alternative techniques for optimally allocated natural resources are investigated. (Lec. 3) *Pre: 528 or permission of instructor.* Wichelns

**540 Applied Resource Economics (II, 3)** Examines issues in agricultural and natural resource policy through applications of theoretical and empirical tools. Applications include pollution control, fisheries management, water, and agricultural policy. (Lec. 3) *Pre: ECN 528 and ECN 376 or permission of instructor.* Opaluch

**543 Economic Structure of the Fishing Industry (I, 3)** Analysis of fishing industries from the standpoint of activity and efficiency. Problems related to common property resources, government policy, labor, and legal and institutional factors. (Lec. 3) *Pre: 514 or permission of instructor.* Staff

**576 Econometrics**  
See Economics 576.

**591, 592 Special Projects (I and II, 1–3 each)** Advanced work under staff supervision arranged to suit the individual requirement of the student. *Pre: permission of chairperson.* Sutinen

**595 (or ECN 595, MAF 595, PSC 595, SOC 595) Problems of Modernization in Developing Nations (II, 3)** Selected regional problems in the environmental complex, agricultural systems, population dynamics, distribution systems, political integration, urbanization-industrialization, popular participation, integrated theories of modernization. (Lec. 3) *Pre: permission of instructors.* Krause (marine affairs), Weaver (resource economics), Poggie (sociology and anthropology), and Suzawa (economics)

**598 Master's Nonthesis Research (I and II, 1–3)** Credit for completion of major paper. *Pre: enrollment in nonthesis master's program in resource economics.* Staff

**599 Master's Thesis Research (I and II)** Number of credits is determined each semester in consultation with the major professor or program committee. *S/U credit.*

**602 Research Methodology (I, 3)** Evaluation of alternative research methods and techniques. Development of specific research projects. (Lec. 3) *In alternate years. Next offered 1993–94.* Gates and Weaver

**610 Advanced Studies (I and II, 1–3)** Advanced topics in resource economics. Mathematical models in resource management. (Lec. 3) *May be repeated with different topics.* Staff

**630 Resource Analysis**  
See Economics 630.

**634 Economics of Resource Development (II, 3)** Concepts of economic efficiency applied to natural resources with emphasis on intertemporal allocation of nonrenewable and renewable resources. Application of welfare and institutional economics to resource management and development; analysis of optimum allocation among users. (Lec. 3) *Pre: 534.* Sutinen

**635 Marine Resources Policy (I, 3)** Analysis of public policy problems relating to the development and management of marine resources, including fisheries, minerals, petroleum, water, and recreation. (Lec. 3) *Pre: 534. In alternate years. Next offered 1994–95.* Grigalunas

**676 Advanced Econometrics**  
See Economics 676.

**677 Econometric Applications in Resource Economics (II, 3)** Special topics in econometrics as applied to agriculture and natural resources. Topics include time series models. Bayesian analysis and dichotomous dependent variables. *Pre: 676.* Tyrrell

**699 Doctoral Dissertation Research (I and II)** Number of credits is determined each semester in consultation with the major professor or program committee. *S/U credit.*

## ECN Courses Economics

**402 Urban Economics** (I or II, 3)

**403 Corporate Crime and Government Regulation** (I or II, 3)

**404 Political Economy of Class, Race, and Gender** (I or II, 3)

**444 Applied Research in Economics** (II, 3)

**512 History of Economic Analysis** (I, 3)  
Advanced work on formative developments in economic thought from classical political economy to modern welfare economics. Emphasis on relationships between doctrines and their institutional setting. (Lec. 3) Pre: permission of instructor. Ramstad

**515, 516 Economic Research** (I and II, 1–3 each) Independent research. S/U credit. Staff

**526 Economics of Labor Markets**  
See Labor and Industrial Relations 526.

**527 Macroeconomic Theory** (II, 3) Static and dynamic models of aggregate economic behavior developed and analyzed. (Lec. 3) Pre: 327 and 375 or equivalent, or permission of instructor. Mead

**528 Microeconomic Theory** (I, 3) Analytic tools of optimization. Neoclassical price and distribution theory. Linear programming and production theory. General equilibrium and welfare economics. (Lec. 3) Pre: 328 and 375 or equivalent, or permission of instructor. Suzawa

**532 Industrial Organization and Public Policy** (II, 3) Theoretical and empirical analysis of structure of industrial markets; behavior and performance of business firms in the American economy; government-business relationship and its effect on formulation of public economic policy. (Lec. 3) Pre: 337 or permission of instructor. Ramsay

**534 Information Sources and Uses in Labor Relations and Labor Economics**  
See Labor and Industrial Relations 534.

**538 International Economics** (I or II, 3) Theory and evidence on international trade and finance. Includes determinants and welfare effects of foreign trade, international investment, migration, exchange rates, and the balance of payments. (Lec. 3) Pre: 327 and 328 or permission of instructor. Burkett

**543 Public Finance and Fiscal Policy** (II, 3) Analysis of private wants and public needs. Serves as introduction to a searching examination of such federal and federal-state fiscal problems as budgetary theory and procedures, tax theory, and reform. (Lec. 3) Pre: 342 or permission of instructor. Starkey

**544 International Financial Economics** (II, 3) History, theory, and politics of the international financial system. Topics include the foreign exchange market, international banking, macroeconomic stabilization under fixed and floating exchange rates, exchange rate reform, and the global debt crisis. (Lec. 3) Pre: 327. McIntyre

**552 Monetary Theory and Policy** (II, 3) Analysis of structure and functioning of monetary and banking systems; discussion of contemporary monetary theories; evaluation of monetary policies. (Lec. 3) Pre: 334 or permission of instructor. Barnett

**566 Economic Planning and Public Policy in Developing Nations** (II, 3) Resource and financial planning in public and private sectors of developing nations with emphasis on planning tools, allocation of domestic and foreign resources, and on national economic policies. (Lec. 3) Pre: 327 and 363 or 464, or equivalent, or permission of instructor. Sharif

**575 Introduction to Mathematical Economics** (I, 3) Application of basic quantitative methods to economic analysis. Dynamic and static economic models will be studied with emphasis on obtaining solutions. (Lec. 3) Pre: 327, 328, and MTH 141 or permission of instructor. Miller

**576 Econometrics** (I, 4) Application of statistics and mathematics to economic analysis. Implication of assumption required by statistical methods for testing economic hypotheses. Current econometric methods examined and discussed. (Lec. 3) Pre: 575 or equivalent, EST 308 or equivalent, or permission of instructor. Lardaro

**590 Principles of Economics** (I and II, 3) Survey of micro- and macroeconomic theory. (Lec. 3) Pre: graduate standing in accounting, labor and industrial relations, or M.B.A. program. Lardaro

**595 Problems of Modernization in Developing Nations**  
See Resource Economics 595.

**599 Master's Thesis Research** (I and II) Number of credits is determined each semester in consultation with the major professor or program committee. S/U credit.

**628 Advanced Microeconomic Theory** (II, 3) Neoclassical value and distribution theory. Theories of imperfect competition, general equilibrium theory, and dynamic analysis. (Lec. 3) Pre: 527 and 528 or permission of instructor. Staff

**630 (or REN 630) Resource Analysis** (I, 3) Development and application of welfare theory to natural resource use. Welfare concepts such as consumer surplus, producer surplus, and marginal cost pricing in policy decisions for agriculture and natural resources. Pre: 628 or permission of instructor. In alternate years. Next offered 1994–95. Staff

**676 (or REN 676) Advanced Econometrics** (II, 4) A course covering the tools necessary for professional research in resource economics. Reviews the general linear model, but emphasis is on simultaneous equation models. Assumes a knowledge of introductory econometrics, statistical theory, and matrix algebra. (Lec. 4) Pre: 576 or its equivalent. Staff

## Spanish

M.A.  
401-792-5911

### Graduate Faculty

*Chairperson:* Professor John M. Grandin, Ph.D., 1970, University of Michigan  
*Director of Graduate Studies:* Professor Robert Manteiga, Ph.D., 1977, University of Virginia  
Professor David M. Gitlitz, Ph.D., 1968, Harvard University  
Professor Michael Navascués, Ph.D., 1971, Rutgers–The State University  
Associate Professor Thomas D. Morín, Ph.D., 1975, Columbia University  
Associate Professor Mario Trubiano, Ph.D., 1979, University of Massachusetts  
Assistant Professor Clement White, Ph.D., 1987, Brown University

### Specializations

The Master of Arts in Spanish is designed for those who wish to perfect their undergraduate achievement in the general area of Hispanic studies, including language mastery and understanding of literature in the total context of civilization and culture. The literary production of Spain, Spanish America, and the Spanish-speaking peoples of the United States will be studied. Any one of these areas could provide a field for specialization.

### Master of Arts

*Admission requirements:* undergraduate major in Spanish or equivalent, including 12 credits in Spanish or Hispanic-American literature. Qualified students may be admitted with less than 12 credits but must make them up without graduate credit.

*Program requirements:* all work carried out in Spanish. Thesis option—30 credits including 6 thesis research credits. Nonthesis option—30 credits. All candidates must pass a written comprehensive examination and an oral comprehensive examination. Course work may be completed on campus or through the URI summer study program in Salamanca, Spain, or a combination of both.

## SPA Courses Spanish

**401 Oral and Dramatic Presentation of Hispanic Literature** (I, 3)

**421 Business Spanish** (I or II, 3)

**430 Castilian Prose of the Sixteenth and Seventeenth Centuries** (II, 3)

**431 Drama and Poetry of the Sixteenth and Seventeenth Centuries** (II, 3)

**451 The Spanish Novel of the Nineteenth Century** (I, 3)

**470 Topics in Hispanic Literature** (I and II, 3)

**481 Don Quixote** (I, 3)

**485 Modern Spanish Narrative** (II, 3)

**486 Modern Spanish Poetry and Drama** (II, 3)

**488 Spanish-American Poetry and Drama** (I or II, 3)

**489 The Spanish-American Narrative** (I or II, 3)

**497, 498 Directed Study** (I and II, 3 each)

**510 Contemporary Spanish Workshop** (SS, 3-6) New developments in all areas of Hispanic studies including pedagogical matters and classroom techniques. (Lec. 3-6) *Pre: graduate standing or permission of instructor.* Staff

**561 Seminar in Medieval Poetry and Prose** (I, 3) Examination and analysis of the epic, lyrical, and narrative medieval literature of Spain and its impact on subsequent literature. (Sem. 3) *Pre: graduate standing or permission of instructor.* Trubiano or Navascués

**570 Topics in Hispanic Literature and Culture** (I, II, or SS, 3) Special topics or authors not emphasized in other courses. (Lec. 3) *Pre: graduate standing or permission of instructor.* Trubiano or Staff

**572 Evolution of Spanish-American Culture and Thought** (II, 3) Development of Spanish-American thought and cultural trends, as portrayed in major works of artists and thinkers. (Lec. 3) *Pre: graduate standing or permission of instructor.* In alternate years. Next offered spring 1994. Morín or White

**574 Interpretations of Modern Spanish-American Thought** (I or II, 3) Topics of interest in the development of modern Spanish-American thought as represented in the essay from the period of independence to the present. (Sem. 3) *Pre: graduate standing or permission of instructor.* Morín or White

**580 Seminar in Nineteenth-Century Spanish Literature** (I or II, 3) Selected authors and topics from the Spanish Romantic movement through realism and naturalism. (Sem. 3) *Pre: graduate standing or permission of instructor.* May be repeated with different topic and permission of instructor. Navascués or Trubiano

**584 Interpretations of Modern Spain** (I, 3) Development of Spanish thought particularly with respect to sociological and cultural problems from the eighteenth century to the contemporary period as seen through the writings of significant essayists. (Lec. 3) *Pre: graduate standing or permission of instructor.* In alternate years. Next offered spring 1994. Manteiga or Navascués

**585 Seminar in Twentieth-Century Spanish Literature** (I, 3) Topics of aesthetic, cultural, and linguistic concern in twentieth-century peninsular literature. (Sem.) *Pre: graduate standing or permission of instructor.* May be repeated with different topic and permission of instructor. Manteiga

**587 Seminar in Renaissance and Baroque Literature** (II, 3) Aesthetic analysis of works representative of the period and their influence on subsequent literatures. (Sem. 3) *Pre:*

*graduate standing or permission of instructor.* May be repeated with different topic and permission of instructor. Trubiano

**588 Seminar in Colonial Spanish-American Literature and Culture** (I or II, 3) Topics of interest dealing with the development of Spanish-American cultural identity and literature from the period of discovery and colonization to independence. (Sem. 3) *Pre: graduate standing or permission of instructor.* Morín or White

**589 Seminar in Modern Spanish-American Literature and Culture** (I or II, 3) Topics of interest dealing with the development of Spanish-American literature and culture from the period of independence to the present. (Sem. 3) *Pre: graduate standing or permission of instructor.* May be repeated with a different topic. Morín or White

**590 The Hispanic Presence in the United States** (II, 3) A study of the establishment of the Hispanic presence and its heritage in the art, folklore, and language of the United States, and an analysis of the literature of the Spanish-speaking peoples. (Lec. 3) *Pre: graduate standing or permission of instructor.* In alternate years. Next offered fall 1994. Staff

**597, 598 Directed Study** (I and II, 3 each) Individual research and reports on problems of special interest. *Pre: graduate standing and approval of the director of graduate studies.* May be repeated with different topic. Staff

**599 Master's Thesis Research** (I and II) Number of credits is determined each semester in consultation with the major professor or program committee. *S/U credit.*

## Speech-Language Pathology and Audiology

M.A., M.S.  
401-792-5969

### Graduate Faculty

*Chairperson:* Associate Professor Jay Singer, Ph.D., 1976, Case Western Reserve University  
Professor Walter J. Beaupre, Ph.D., 1962, Columbia University  
Professor Barbara Culatta, Ph.D., 1975, University of Pittsburgh  
Professor Agnes Doody, Ph.D., 1961, Pennsylvania State University  
Professor Stephen D. Grubman-Black, Ph.D., 1972, State University of New York, Buffalo  
Assistant Professor Ovetta L. Harris, Ph.D., 1992, University of Massachusetts  
Assistant Professor John P. Preece, Ph.D., 1985, University of Iowa

### Specializations

Audiology and speech-language pathology.

### Master of Arts and Master of Science

*Admission requirements:* 19 undergraduate credits in communicative disorders (always including CMD 372, 373, 374, 375, 376, and 465, or equivalents). Although cumulative average is not the sole criterion for admission to the graduate programs in speech-language pathology and audiology, those applicants with overall quality point averages of less than 3.00 (on a 4.00 scale) may be advised to address background deficits to gain admission to the program. The completed application package must be received by October 15 for spring admission and March 1 for fall admission.

*Program requirements:* for M.A. in speech-language pathology (46 credits), thesis; CMD 504; 26 credits in speech pathology and seven credits in audiology. For M.A. in audiology (46 credits), thesis; CMD 504; 26 credits in audiology and seven credits in speech pathology. For M.S. in speech-language pathology (46 credits), no thesis; written comprehensive examination; CMD 504; 32 credits in speech pathology and seven credits in audiology. For M.S. in audiology (46 credits), no thesis; written comprehensive examination; CMD 504; 32 credits in audiology and 7 credits in speech pathology. For either the M.A. or M.S. program in speech-language pathology or audiology, students must complete 25 hours of directed observations and a minimum of 350 supervised clock hours of practicum in addition to the academic requirements. Because program requirements in both speech-language pathology and audiology include clinical responsibilities, the average length of time to complete any of the programs is two academic years.

*Accelerated bachelor's/master's option for speech-language pathology or audiology students:* University of Rhode Island senior undergraduate majors in communicative disorders who have met requirements for early acceptance in the graduate program of either audiology or speech-language pathology may follow a special sequence of graduate-level course work and clinical practicum during their senior year. If eligible, following the award of the Bachelor of Science degree in communicative disorders, students may complete a 30-semester-hour master's degree (rather than the usual 46-semester-hour master's degree) in one year of full-time graduate study. This option, which requires careful sequencing of senior and graduate course work, is not available to students from other undergraduate institutions nor to students who elect part-time graduate study prior to completion of the fifth year.

*Admission requirements:* URI sixth-semester standing in communicative disorders with all major requirements completed and 25 elective credits remaining; a 3.00 cumulative quality point average and 3.20 in the major through the fifth semes-

ter; and two letters of recommendation from URI communicative disorders faculty.

**Program requirements:** for students who have taken the specified 25 credits (16 of which must be at the 500 level) of communicative disorders course work in the senior year to complete the bachelor's degree in communicative disorders, 30 credits of course work in the fifth year (postbaccalaureate) at the 500 level. Specific course requirements are as stated in the regular two-year master's program.

## **CMD Courses Communicative Disorders**

**475 Gestural Communication (II, 3)**  
**491, 492 Special Problems**  
(I and II, 1-3 each)

**504 Speech and Hearing Research (II, 3)** Types of research in speech pathology, audiology, and communication science; critiques of representative models with special emphasis on experimental research; individual pilot projects or master's thesis. (Lec. 3) Pre: 372, 373, 374, 375, *graduate standing, or permission of instructor.* Staff

**506 Speech and Hearing Science (I, 3)** Critical analysis of experimental data concerning the parameters of speech and the fundamental concepts in normal audition. Course will include introduction to instrumentation. (Lec. 1, Lab. 2) Pre: 504 or *permission of instructor.* Staff

**551 Measurement of Hearing (I, 3)** Diagnostic protocols and practicum for routine audiological assessment; etiology and symptomatology of hearing disorders; overview of aural rehabilitation including hearing aids. (Lec. 2, Lab. 1) Pre: 372, 373, 374, 375, *graduate standing, or permission of instructor.* Singer

**552 Advanced Measurement of Hearing (II, 3)** Advanced audiometrics; speech audiometry; immittance measures, cochlear measures; retrocochlear measures; pseudohypacusis measures, and central auditory measures. (Lec. 2, Lab. 2) Pre: 551 or *permission of instructor.* Staff

**553 Pediatric Audiology (I, 3)** Theoretical and methodological approaches to the identification and management of children with auditory disorders. Topics discussed include auditory development, audiometric evaluation, and hearing aids. (Lec. 3) Pre: 551 or *permission of instructor.* Staff

**554 Rehabilitative Audiology (I, 3)** Theoretical and methodological approaches to aural rehabilitation of the hearing-impaired adult. Topics discussed include use of amplification, speech reading, auditory training, and case management. (Lec. 3) Pre: 551 or *permission of instructor.* Staff

**555 Amplification for the Hearing Impaired (II, 3)** Electroacoustics and psychoacoustics of wearable hearing aids; selection and fitting procedures, counseling; classroom amplification systems. (Lec. 3)

Pre: 372, 373, 374, 375, *graduate standing, or permission of instructor.* In alternate years. Singer

**556 Electrophysiological Measures in Audiology (II, 3)** Basic electrophysiologic procedures, instrumentation, electrocochleography, auditory brain stem responses, and middle, late, and long-latency auditory evoked potentials. (Lec. 2, Lab. 2) Pre: 551, 552, or *permission of instructor.* Staff

**560 Disorders of Phonation (II, 3)** Etiology and symptomatology of vocal pathology; intervention strategies for organic and functional voice disorders; emphasis on rehabilitation team approach to voice-resonance problems associated with cleft palate. (Lec. 3) Pre: 372, 373, 374, 375, *graduate standing, or permission of instructor.* Beaupre

**561 Articulation Disorders (I, 3)** Assessment, design, and implementation of therapeutic management programs for various speech production disorders at the articulatory and phonological levels. (Lec. 3) Pre: 372, 373, 374, 375, or *equivalent, or permission of instructor.* Staff

**564 Language Disorders in School-Aged Children (II, 3)** Study of communication deficits in learning-disabled school-aged children; differential diagnoses; assessment of cognitive functioning; language processing and discourse; therapeutic strategies for training abstract and functional language. (Sem. 3) Pre: *graduate standing or permission of instructor.* Culatta

**567 Clinical Practicum in Speech Pathology (I and II, 1-3)** Supervised diagnostic and therapeutic procedures with persons experiencing communicative disorders. Differential diagnosis, parent counseling, and cooperation with allied personnel. Practicum held on campus and within institutional and school settings. (Lab. 3-9) Pre: *graduate standing.* Staff

**568 Clinical Practicum in Audiology (I and II, 1-3)** Supervised clinical practicum concerned with audiological assessment of hearing disorders and auditory rehabilitation with the hearing impaired. Practicum held on campus and within institutional and school setting. (Lab. 3-9) Pre: 551 and *graduate standing.* Staff

**569 Diagnostic Procedures (I, 3)** Major procedures for assessment and evaluation in speech-language pathology. Implications of diagnostic data for referrals, prognosis, therapeutic programs, and consultations. (Lec. 3) Pre: 372, 373, 374, 375, or *equivalent, or permission of instructor.* Staff

**570 Clinical Practicum in Communicative Disorders (I and II, 1-5)** Supervised assessment and rehabilitation procedures with persons experiencing communicative disorders in speech-language pathology and/or audiology. Practicum sites scheduled on campus and within hospital, school, institutional, and private settings. (Lab. 2-10 hours) Pre: *graduate standing, 25 observation hours, and appropriate course work.* Staff

**572 Medical Audiology (I, 3)** Diagnostic implications of audiometry for various organic disorders; supportive audiological information relevant to medical and surgical interventions; differential data associated with otosclerosis, Meniere's disease, VIIIth cranial nerve tumors, and malingering. (Lec. 3) Pre: 372, 373, 374, 375, *graduate standing, or permission of instructor.* Staff

**573 Contemporary Problems in Audiology (II, 3)** Critical review of current research and controversial issues within the profession; student selects one topic for independent study. (Lec. 3) Pre: 372, 373, 374, 375, *graduate standing, or permission of instructor.* Staff

**574 Environmental Audiology (II, 3)** Hearing problems in industry, in the military, and other high-noise-level environments; medico-legal aspects of hearing loss; hearing conservation programs in public schools. (Lec. 3) Pre: 372, 373, 374, 375, *graduate standing, or permission of instructor.* Singer

**577 Speech and Language for Hearing-Impaired (II, 3)** Assessment, development and/or maintenance of voice, speech, and language skills associated with congenital or adventitious deafness; seminar approach to strategies in current practice with children and adults. (Sem. 3) Pre: 372, 373, 374, 375, *graduate standing, or permission of instructor.* Beaupre

**580 Augmentative Communication (II, 3)** Assessment, selection, and implementation of augmentative communication devices and systems for severely communicatively impaired persons emphasizing the transdisciplinary approach, fabrication, and experience with current electronic equipment. (Lec. 3) Pre: *course work in aphasia, cerebral palsy, or head trauma, and permission of instructor.* Lytton or Carlson

**581 Cerebral Palsy (I, 3)** Identification of type of cerebral palsy by location of lesion, motor symptomatology, and additional handicaps; role of the speech clinician on the team; types of speech therapy with emphasis on the Bobath approach; current research and controversial issues. (Lec. 3) Pre: 372, 373, 374, 375, *graduate standing, or permission of instructor.* Staff

**582 Motor Speech Disorders (II, 3)** Diagnosis and management of apraxia of speech and dysarthrias. Aspects of neuro-anatomy relevant to the production of speech. Etiologies of motor speech disorders including neuromotor diseases, stroke, and trauma. (Lec. 3) Pre: *admission to graduate program and 372 or equivalent. In alternate years. Next offered spring 1995.* Staff

**584 Language Disorders in Developmentally Young Children (I, 3)** Study of communication deficits in developmentally young and multihandicapped children; types of language problems; differential diagnoses; assessment of conceptual requisites and concrete language skills; interactive therapeutic strategies. Pre: *graduate standing or permission of instructor.* Culatta

**585 Aphasia and Allied Language Disorders (II, 3)** Types of adult aphasia; central and peripheral dysarthrias; role of speech clinician on the rehabilitation team; other degenerative disorders such as Parkinsonism and dystonia; current research and controversial issues. (Lec. 3) Pre: 372, 373, 374, 375, *graduate standing, or permission of instructor.* Staff

**586 Alaryngeal Speech (I, 3)** Voice and speech rehabilitation for individuals without a functional larynx; social, emotional, and medical considerations; clinical procedures for esophageal, pharyngeal, and buccal speech; implications for use of artificial larynx; current research. (Lec. 3) Pre: 372, 373, 374, 375, *graduate standing, or permission of instructor.* Beaupre

**591 Contemporary Issues in Speech and Language Pathology (II, 3)** Critical review of selected current research and controversial issues in the profession. Topics will vary each offering. (Sem. 3) Pre: *minimum of 15 graduate credits in speech-language pathology, including 504, or permission of instructor. May be repeated for a maximum of 6 credits.* Beaupre and Culatta

**592 Stuttering and Cluttering (I, 3)** Study of nature and causes of stuttering; analyses of current theories and research concerning stuttering and cluttering; development of a rationale for diagnosis, case selection, and intervention. (Lec. 3) Pre: *graduate standing and/or permission of instructor.* Staff

**599 Master's Thesis Research (I and II)** Number of credits is determined each semester in consultation with the major professor or program committee. *S/U credit.*

## Statistics

M.S.  
401-792-2701

### Graduate Faculty

*Chairperson:* Associate Professor Edmund A. Lamagna, Ph.D., 1975, Brown University  
*Section Head:* Professor R. Choudary Hanumara, Ph.D., 1968, Florida State University  
Professor Edward J. Carney, Ph.D., 1967, Iowa State University  
Professor James F. Heltshie, Ph.D., 1973, Kansas State University  
Associate Professor William D. Lawing, Ph.D., 1965, Iowa State University  
Assistant Professor Colleen Kelly, Ph.D., 1991, University of California, San Diego

### Specializations

Experimental design, sampling, ecological statistics and biostatistics, statistical computation, simulation, multivariate analysis, nonparametric methods, classification and discrimination, analysis of variance, bootstrap and jackknife estimation, sequential methods.

### Master of Science

*Admission requirements:* bachelor's degree including the equivalent of MTH 141, 142 Introductory and Intermediate Calculus with Analytic Geometry; MTH 243 Calculus for Functions of Several Variables; MTH 215 Introduction to Linear Algebra; CSC 201 Introduction to Computing; EST 409 Statistical Methods in Research I. GRE (advanced test in mathematics or undergraduate field is desirable).

*Thesis option program requirements:* a minimum of 24 credits (exclusive of thesis) including MTH 451, EST 412, either EST 501 or 502, and at least nine additional credits selected from EST 500, 501, 502, 520, 541, 542, 550, 592, 611.

*Nonthesis option program requirements:* 33 credits distributed as follows:

- 1) MTH 451, EST 412, and either EST 501 or 502.
- 2) At least nine credits selected from EST 500, 501, 502, 520, 541, 550, 592, 611.
- 3) At least six of the remaining credits must be at the 500 level or above (exclusive of EST 591).
- 4) The above course work must include at least one course that requires a substantial paper involving significant independent study.
- 5) Written comprehensive examination.

### Doctor of Philosophy

See Applied Mathematical Sciences on page 28.

### General Information

Programs of study can be designed for individuals who are employed on a full-time basis.

### EST Courses

#### Experimental Statistics

**409 Statistical Methods in Research I (I and II, 3 each)**

**412 Statistical Methods in Research II (I and II, 3)**

**413 Data Analysis (I or II, 3)**

**491 Directed Study in Experimental Statistics (I and II, 1-3)**

**492 Special Topics in Experimental Statistics (I or II, 3)**

**500 Nonparametric Statistical Methods (I or II, 3)** Rank and sign tests, permutation tests and randomization, run test, tests of goodness of fit, order statistics, estimation, and comparison with parametric procedures. Examples illustrating the applications of nonparametric techniques. (Lec. 3) Pre: 308 or 409. Staff

**501 Analysis of Variance and Variance Components (I or II, 3)** Analysis of variance and covariance, experimental design models, factorial experiments, random and mixed models, estimation of variance components, unbalanced data. (Lec. 3) Pre: 412. Staff

**502 Applied Regression Analysis (I or II, 3)** Topics in regression analysis including subset selection, biased estimation, ridge regression, and nonlinear estimation. (Lec. 3) Pre: 412. Staff

### 517 Small N Designs

See Psychology 517.

**520 Fundamentals of Sampling and Applications (I or II, 3)** Simple random sampling; properties of estimates, confidence limits. Sample size. Stratified random sampling; optimum allocation, effects of errors, and quota sampling. Regression and ratio estimates; systematic and multistage sampling. (Lec. 3) Pre: 308 or 409. Staff

**532 (or ASP 532 or PSY 532) Experimental Design (I, 3)** Application of statistical methods to biological and psychological research and experimentation. Experimental situations for which various ANOVA and ANCOVA designs are most suitable. (Lec. 3) Pre: 308 or 409 or equivalent. Staff

**541 Multivariate Statistical Methods (I or II, 3)** Review of matrix analysis. Multivariate normal distribution. Tests of hypotheses on means, Hotelling's  $T^2$ , discriminate functions. Multivariate regression analysis. Canonical correlations. Principal components. Factor analysis. (Lec. 3) Pre: 412. Staff

**542 Discrete Multivariate Methods (I or II, 3)** Analysis of multidimensional categorical data by use of log-linear and logit models. Discussion of methods to estimate and select models followed by examples from several areas. (Lec. 3) Pre: 412. Staff

**550 Ecological Statistics (I or II, 3)** Application of statistical methodology to the following topics: population growth, interactions of populations, sampling and modeling of ecological populations, spatial patterns, species abundance relations, and ecological diversity and measurement. (Lec. 3) Pre: 409 or permission of instructor. Staff

**576 Econometrics**  
See Resource Economics 576.

**584 Pattern Recognition**  
See Electrical Engineering 584.

**591 Directed Study in Experimental Statistics (I and II, 1-3)** Advanced work in experimental statistics conducted as supervised individual projects. Pre: *permission of chairperson.* *S/U credit.* Staff

**592 Special Topics in Experimental Statistics (I or II, 3)** Advanced topics of current interest in experimental statistics. (Lec. 3) Pre: *permission of chairperson.* Staff

**599 Master's Thesis Research (I and II)** Number of credits is determined each semester in consultation with the major professor or program committee. *S/U credit.*

**610 Parsimony Methods**

See Psychology 610.

**611 Linear Statistical Models (I or II, 3)**

Review of mathematical and statistical concepts. Multivariate normal distribution. Distribution of quadratic forms. Power of the F-test. Basic linear models: general linear hypothesis, regression models, experimental design models, variance component models, mixed models. (*Lec. 3*) *Pre: 501 or 502.* Staff

**612 Structural Modeling**

See Psychology 612.

**635 Response Surfaces and Evolutionary Operations**

See Industrial and Manufacturing Engineering 635.

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**Teacher Certification**

Students who did not obtain Rhode Island Teacher Certification as part of their undergraduate studies may do so by being admitted to a teacher certification program and satisfactorily completing a prescribed set of courses in the appropriate fields. Such applicants should indicate the specific TCP program code on the application forms and submit two official transcripts of all prior academic work, showing receipt of the bachelor's degree, plus a personal statement of objectives and two letters of recommendation. Applications for the education program are reviewed each May; admission is competitive. If space becomes available for any particular TCP program, completed applications for that program may be reviewed subsequently. A test of basic skills is required prior to action on your application. The NTE Communications and General Knowledge tests are required as part of the admissions process for the resource development (agriculture), physical education, and music education programs. For all other teacher education programs, the basic skills requirement consists of mathematics and writing tests administered by the Department of Education each spring. Please contact the appropriate department(s) listed below for additional information relative to this requirement. An interview is also required of all applicants. Students admitted to the TCP program are governed by the same academic standards as matriculated graduate students. Further information can be obtained from the Office of Teacher Education at 401-792-5930 or from the following areas of specialization:

*Early Childhood Education (510):* Associate Professor David Caruso, Chairperson, Department of Human Development and Family Studies, 401-792-2150

*Elementary Education (513):* Assistant Professor Betty Young, Department of Education, 401-792-4150

*Secondary Education (513):*

English: Associate Professor Richard Nelson, Department of Education, 401-792-4165  
Mathematics: Professor John Long, Department of Education, 401-792-4149  
Science: Professor William Croasdale, Department of Education, 401-792-4161  
Social Studies: Professor Robert MacMillan, Department of Education, 401-792-4155  
Languages: Professor Joann Hammadou, Department of Languages, 401-792-4712

*Music Education (070):* Assistant Professor Carolyn Livingston, Department of Music, 401-792-2431

*Physical Education (580):* Professor Jeannette Crooker, Department of Physical Education, Health, and Recreation, 401-792-2976

*Resource Development (Agriculture):* Assistant Professor Anthony Mallilo, Department of Resource Development Education, 401-792-2981

*School Library Media (940):* Assistant Professor Cheryl McCarthy, Graduate School of Library and Information Studies, 401-792-2878

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**Textiles, Fashion Merchandising, and Design**

M.S.  
401-792-4574

**Graduate Faculty**

*Chairperson:* Associate Professor Linda M. Welters, Ph.D., 1981, University of Minnesota  
Professor Joy Emery, M.A., 1966, Ohio State University  
Associate Professor Martin J. Bide, Ph.D., 1979, University of Bradford, United Kingdom  
Associate Professor Misako Higa, Ph.D., 1973, University of Minnesota  
Associate Professor Patricia A. Helms, Ph.D., 1971, Florida State University  
Assistant Professor Yvette Harps-Logan, Ph.D., 1990, Virginia Polytechnic Institute and State University  
Assistant Professor Margaret Ordoñez, Ph.D., 1978, Florida State University  
Adjunct Professor Laurence F. Gross, Ph.D., 1976, Brown University  
Adjunct Professor Paul Hudon, Ph.D., 1971, Georgetown University  
Adjunct Professor Alexander J. Patton, Ph.D., 1972, University of Rhode Island

The department offers a wide variety of individualized programs in close association with other departments (Art, Chemistry, Education, History, Human Development and Family Studies, Marketing) and with various social science fields.

**Master of Science**

*Specializations:* textile science, historic textiles and costume, textile conservation, and fashion merchandising.

*Admission requirements:* GRE and a bachelor's degree with adequate preparation for the proposed area of study.

*Program requirements:* thesis option—completion of a minimum of 30 credits, including six credits of thesis research. Nonthesis option—completion of a minimum of 33 credits, half of which must be TMD courses numbered 500 or above, including at least one course that requires a substantial paper involving significant independent study, and written comprehensive exams. TMD 510 is a requirement for all students. For the textile science specialization—TMD 503 and 510; half of the remaining elective credits must be from TMD courses numbered 500 or above. For the historic textiles and costume specialization—TMD 510, 520, 524, and a supervised internship (TMD 530, 2–4 credits); half of the remaining elective credits must be from TMD courses numbered 500 or above. A minimum of nine credits is required to achieve a competency level in an allied field such as art history, history, or anthropology; this may result in a program of more than 30 credits. The committee may elect to waive this requirement if the candidate has adequate preparation in the allied field as an undergraduate. Candidates lacking undergraduate courses in textile science and historic costume may be required to make up deficiencies without graduate credit. For the fashion merchandising specialization—TMD 510 and 524; six credits to be selected from TMD 532, 542, and 552; half of the remaining elective credits must be from TMD courses numbered 500 or above. Candidates lacking undergraduate courses in textile science and fashion merchandising may be required to make up deficiencies without graduate credit.

**TMD Courses****Textiles, Fashion Merchandising, and Design**

- 402 (502) Seminar in Textiles and Clothing (II, 1–2)**
- 403 Textile Performance (I, 3)**
- 406 Historic Furniture (I, 3)**
- 413 Dyeing and Finishing of Textiles (II, 3)**
- 416 Interior Design II (I, 3)**
- 424 Fashion Theory and Analysis (I or II, 3)**
- 432 Fashion Merchandising Operations Control (II, 3)**
- 433 Textile Markets (I and II, 3)**
- 440 Historic Textiles (I, 3)**
- 453 (533) Textiles: A Global Perspective (I, 3)**
- 496 Interior Furnishings and Design Internship (II, 3)**

**500 Ethnic Costume and Textiles (I, 3)** Survey of regional styles of costume and textiles from all areas of the world, excluding fashionable dress. Influence of social, economic, technological, and aesthetic factors. (Lec. 3) *Pre: 224 or equivalent, 340, 440, or permission of instructor. In alternate years.* Welters

**503 Topics in Textile Science (I or II or SS, 3)** Advanced study in a particular area of textile science. One topic will be studied from a list that includes dyeing, finishing, printing, polymer and fiber chemistry, dye-stuff chemistry, and color science. (Lec. 2, Lab. 2) *Pre: graduate standing, 303 or equivalent, or permission of instructor. May be repeated up to three times with different topics.* Bide

**510 Research Methods in Textiles (I, 3)** Application of research methodology to the study of textiles and clothing. Approach is multidisciplinary in that experimental, social science, and historic methods are covered. (Lec. 3) *Pre: graduate standing or permission of instructor.* Welters

**513 Detergency (I, 3)** Study of chemical and mechanical interactions of textile fibers, fabrics, laundering products, equipment, and soils. Laboratory experience in evaluation of laundry products and fabric durability during laundering. (Lec. 2, Lab. 2) *Pre: graduate standing, 303 or equivalent, and permission of instructor. In alternate years.* Ordoñez

**520 Introduction to Textile Conservation (I, 3)** Survey of methods used to clean, repair, store, and display historic textiles and costumes. Laboratory experience in conservation practices. (Lec. 2, Lab. 2) *Pre: a textile science course and historic textiles or costume course, or permission of instructor.* Ordoñez

**521 Topics in Textile Conservation (II, 1-3)** Investigation of textile conservation theory and methodology. Some topics will include laboratory assignments. *Pre: 520 or experience in textile conservation, and permission of instructor. May be repeated with different topic. Spring 1994: Repair and Stabilization.* Ordoñez

**522 Special Problems in Textile Conservation (I, 1-3)** Supervised independent studies on specific textile conservation projects or research. *Pre: 520 or experience in textile conservation, and permission of instructor. May be repeated for a maximum of 6 credits.* Ordoñez

**524 Social and Psychological Aspects of Textiles and Clothing (I, 3)** Seminar in social and psychological aspects of textiles and clothing. Theories and assumptions concerning relevance of clothing to individuals and groups. (Lec. 3) *Pre: 224 or permission of instructor. Next offered fall 1994.* Staff

**530 Historic Textile Internship (I and II, 2-4)** Supervised internship designed to introduce the student to management of textile and costume collections in a museum or historical society setting. Individually designed to suit student needs—conservation, education, and research. *Pre: 510, 520, graduate standing in textiles, fashion merchandising, and design, or permission of chairperson.* Welters or Ordoñez

**532 Consumer Behavior in Fashion Retailing (I or II, 3)** Use by fashion retailing management of explanatory and predictive models of consumer behavior relating to fashion merchandising in establishing retail policy and strategy. (Lec. 3) *Pre: graduate standing or permission of instructor.* Harps-Logan

**540 Special Problems in Textiles and Clothing (I and II, 3)** Supervised independent study in specific areas of textiles and clothing. *Pre: permission of chairperson.* Staff

**542 Fashion Promotion (I or II, 3)** Emphasis on understanding and applying the principles of fashion retailing communication. Evaluation and application of effective promotional activities such as visual merchandising and fashion shows to trade and retail levels of fashion merchandising. (Lec. 3) *Pre: graduate standing or permission of instructor.* Harps-Logan

**550 Prepracticum (I and II, 3)** Supervised study in intended practicum subject area resulting in written review of literature and proposal for practicum. *Pre: permission of departmental committee.* Staff

**552 Retail Price Strategy (I or II, 3)** Economic, financial, legal, and fashion retailing principles are examined and integrated into a functional model in order to analyze management's pricing decisions and strategies for fashion merchandise. (Lec. 3) *Pre: graduate standing or permission of instructor.* Harps-Logan

**560 Practicum (I and II, 3)** Supervised practicum as proposed in 550. Results reported in both oral and written form. *Pre: 550.* Staff

**570 Topics in Historic Textiles or Costume (I or II or SS, 3)** Advanced study in a particular area of historic textiles or costume using artifactual and documentary primary sources. Use of historic textile and costume collection. (Lec. 3) *Pre: 340, 440 or equivalent. May be repeated for a maximum of 6 credits. Spring 1994: Quilts—Conservation and Curatorial Issues.* Ordoñez or Welters

**596 Interior Furnishing and Design Seminar (II, 3)** Historic and modern furnishings; interior space, structures, and design as they relate to furniture, equipment, fixtures, accessories, interior materials, and fabrics. *Pre: 406 or permission of instructor. In alternate years.* Higa

**599 Master's Thesis Research (I and II)** Number of credits is determined each semester in consultation with the major professor or program committee. *S/U credit.*

## Zoology

M.S., Ph.D. (Biological Sciences)  
401-792-2372

### Graduate Faculty

*Chairperson:* Associate Professor Harold D. Bibb, Ph.D., 1969, University of Iowa  
Professor Robert C. Bullock, Ph.D., 1972, Harvard University  
Professor J. Stanley Cobb, Ph.D., 1969, University of Rhode Island  
Professor Robert F. Costantino, Ph.D., 1967, Purdue University  
Professor Frank H. Heppner, Ph.D., 1967, University of California, Davis  
Professor Robert B. Hill, Ph.D., 1957, Harvard University  
Professor Kerwin E. Hyland, Jr., Ph.D., 1953, Duke University  
Professor Gabriele Kass-Simon, D.Phil., 1967, University of Zurich  
Professor Steffen H. Rogers, Ph.D., 1968, Vanderbilt University  
Professor C. Robert Shoop, Ph.D., 1963, Tulane University  
Professor Jennifer L. Specker, Ph.D., 1980, Oregon State University  
Professor Howard E. Winn, Ph.D., 1955, University of Michigan  
Associate Professor Marian R. Goldsmith, Ph.D., 1970, University of Pennsylvania  
Associate Professor William H. Krueger, Ph.D., 1967, Boston University  
Associate Professor John P. Mottinger, Ph.D., 1968, Indiana University  
Associate Professor Saran Twombly, Ph.D., 1983, Yale University  
Assistant Research Professor David A. Bengtson, Ph.D., 1972, University of Rhode Island  
Adjunct Professor Donald C. Miller, Ph.D., 1965, Duke University  
Adjunct Professor Ruth D. Turner, Ph.D., 1954, Radcliffe College, Harvard University  
Adjunct Assistant Professor Clifford H. Katz, Ph.D., 1982, University of Connecticut  
Adjunct Assistant Professor Thomas N. Mather, Ph.D., 1983, University of Wisconsin

### Specializations

Acarology, animal behavior, animal diversity, cell and tissue biology, developmental biology, ecology, endocrinology, genetics (ecological, molecular, population), herpetology, ichthyology, limnology, mammalogy, marine biology, neurobiology, ornithology, parasitology, physiology, radioecology, reproductive biology, systematics, and taxonomy.

## Master of Science

**Admission requirements:** GRE and bachelor's degree with major in zoology, biology, or allied field. Applicants are normally admitted for September only. The completed application package must be received by April 15. For consideration for financial aid, the application package should be received by February 1.

**Program requirements:** thesis.

## Doctor of Philosophy (Biological Sciences)

**Admission requirements:** master's degree is not required. GRE with advanced test (biology) and bachelor's degree with major in zoology, biology, or allied field. Applicants are expected, but not required, to have a reading knowledge of two languages in addition to their native language. Applicants are normally admitted for September only. The completed application package must be received by April 15. For consideration for financial aid, the application package should be received by February 1.

**Program requirements:** dissertation, qualifying examination required for all candidates except holders of M.S. degree. Although there is no departmental language requirement, the candidate's committee may require demonstration of proficiency in one or two languages other than the candidate's native language. Comprehensive examination.

## ZOO Courses

### Zoology

- 437 (or BOT 437) Fundamentals of Molecular Biology (I, 3)
- 441 Environmental Physiology of Animals (I, 3)
- 442 Mammalian Physiology (II and SS, 3)
- 444 Experimental Physiology (II, 3)
- 445 Endocrinology I (I, 3)
- 455 (or BOT 455) Marine Ecology (I, 3)
- 457 (or BOT 457) Marine Ecology Laboratory (I, 1)
- 460 Advanced Population Biology (II, 3)
- 465 Limnology (I, 4)
- 466 Vertebrate Biology (II, 3)
- 467 Animal Behavior (II, 3)

501 Systematic Zoology (I, 3) Species concepts and theories of biological classification. Taxonomic decisions and publication, numerical taxonomy, and review of the rules of zoological nomenclature. (Lec. 3) Pre: ZOO 262 and BOT 352, 254 or 466 recommended. In alternate years. Next offered 1994. Bullock

505 Biological Photography (I, 2) Application of scientific photography to biological subjects, living and prepared. Photomacrography and photomicrography. Principles of photography as applied to the specialized needs of biological research and publication. (Lab. 6) Pre: permission of instructor. Heppner

508 Seminar in Zoological Literature (II, 1) Survey of zoological literature including traditional methods of bibliographic control, contemporary information retrieval services, and the development of a personalized information system. (Lec. 1) Pre: graduate standing in zoology. Kelland

521 Recent Advances in Cell Biology  
See Microbiology 521.

531 Advanced Parasitology Seminar (II, 2) Advanced topics in the host-parasite relationships of protozoan and metazoan parasites. Reading knowledge of one foreign language assumed. Topics vary from year to year. (Lec. 2) Pre: 331 or equivalent. Hyland

541 Comparative Physiology (I, 3) Comparison of physiological mechanisms by which animals maintain life with emphasis on marine invertebrates. Responses to external environment mediated by receptors, nervous systems, effectors. Living control systems for muscular activity and circulation. (Lec. 2, Lab. 3) Pre: 101 and 201. In alternate years. Next offered 1994-95. Hill

545 Endocrinology II (I, 3) Molecular basis of hormone action and evolution of regulatory systems. (Lec. 3) Pre: BCP 311, ZOO 442, graduate standing, and permission of instructor. In alternate years. Next offered 1993-94. Specker

546 Introduction to Neurobiology (II, 2) Fundamental processes in neurobiology with emphasis on cellular and membrane mechanisms of nerve functioning. (Lec. 2) Pre: 201 and MTH 141. In alternate years. Next offered spring 1994. Pre: 201 and MTH 141. Kass-Simon

547 Laboratory in Electrophysiological Techniques (II, 2) Introduction to methods of extracellular and intracellular electrophysiology of excitable tissues. (Lab. 4) Pre: credit or concurrent enrollment in 546. In alternate years. Next offered spring 1994. Kass-Simon

549, 550, 551 Advanced Topics in Neurobiology (II, 3 each) Published papers in selected aspects of neurobiology will be discussed. Representative topics include role of Ca<sup>++</sup>, c-AMP in the nervous system, gating currents learning at the cellular level, cellular rhythmicity. (Lec. 3) In alternate years. Next offered 1995. Kass-Simon

561 Behavioral Ecology (I, 3) The interaction of animal behavior, ecology, and evolution. Topics include predator-prey relationships, resource partitioning, competition, territoriality, and reproductive behavior. Term project required. (Lec. 1, Rec. 2) Pre: a course in animal behavior and a course in ecology. In alternate years. Next offered 1993-94. Cobb

562 Seminar in Behavioral Ecology (I, 1) Special topics in the relationships between animal behavior and ecology, such as social organization of animals, evolution of behavior, competition, and habitat selection. Discussion and presentation of individual reports. (Lec. 1) S/U only. Cobb

563 Ichthyology (I, 3) Fishes of the world. Their structure, evolution, classification, ecology, and physiology. Emphasis on local marine and freshwater fauna. Several field trips. (Lec. 2, Lab. 3) Pre: 102 or 202 and 466. Krueger

566 Herpetology (II, 3) Biology of recent orders of amphibians and reptiles; emphasis on adaptations and evolution, world faunal relationships past and present, current systematic problems. Selected herpetological material in laboratory, field trips. (Lec. 2, Lab. 3) Pre: 102 or 202 or permission of instructor. Shoop

567 Natural Selection (II, 3) Ideas and controversies concerning the action of natural selection. Maintenance of genetic variability, neutral mutation, levels of selection, recombination and sexual reproduction, and rates of evolution. (Lec. 3) Pre: 262 and BOT 352 or ZOO 104, or permission of instructor. Twombly

568 Ornithology (II, 2) Biology of birds with emphasis on the role of birds in biological research. Areas covered include systematics, evolution, physiology, ecology, and behavior. Discussion of current topics in ornithology. (Lec. 2) Pre: 466 or permission of instructor. Heppner

570 Field Biology of Fishes (II, 3) Selected field problems in fish biology, including distribution and diversity, habitat segregation, reproduction, and natural movements. Emphasis on freshwater and diadromous populations. (Lec. 1, Lab. 5) Pre: 563 or permission of instructor. Limited to 10 students, with preference given to graduate students and senior zoology majors. In alternate years. Next offered 1994-95. Krueger

573 Developmental Genetics (I, 3) Genetic control of gametogenesis and fertilization. Survey of modern approaches to the problem of gene regulation during embryogenesis with animal systems. (Lec. 3) Pre: BOT 352 (or ASP 352) or equivalent and permission of instructor. Goldsmith, Bibb, and Chandlee

579 (or BOT 579) Advanced Genetics Seminar (I and II, 1) Current topics in genetics, including cytological, ecological, molecular, physiological, population, quantitative, and radiation genetics. (Lec. 1) Pre: BOT 352 and permission of instructor. Goldsmith and Mottinger

581 General Acarology (I, 3) Detailed study of mites and ticks, their structure, life histories, and classification. Free-living forms as well as plant and animal feeders. (Lab. 6) Pre: 331 or 586. In alternate years. Next offered 1993-94. Hyland

586 Medical and Veterinary Entomology (II, 3) Life histories, classifications, habits, and control of insects and other arthropods which affect the health of man and animals. Duties of the entomologist on a public health team, including field practice in methods of insect surveys, control measures, and subsequent surveys to determine

success of control measures. (*Lec. 1, Lab. 4*)  
*Pre: 331 or 381 or equivalent. In alternate years. Next offered 1994-95.* Hyland

**587 Seminar in Neurobiology (I or II, 1)**  
Current literature in the neurosciences will be surveyed. Topics include molecular and behavioral electrophysiology, ultrastructure of excitable cells, receptor and pharmacological neurobiology of invertebrates and vertebrates. *Pre: graduate standing or one advanced neuroscience course.* Kass-Simon

**599 Master's Thesis Research (I and II)**  
Number of credits is determined each semester in consultation with the major professor or program committee. *S/U credit.*

**641, 642, 643, 644, 645 Seminar in Physiology (I and II, 1-3 each)** Reports and discussions on topics of current research in physiology. Subject matter adapted to meet interests of staff and students. (*Lec. 1-3*) *Pre: permission of instructor.* Staff

**664 Seminar in Ichthyology (II, 2)** Reading, library research, reports, and class discussion on problems of current research interest in the biology of fishes. (*Lec. 2*) *Pre: 563 or permission of instructor. In alternate years. Next offered 1993-94.* Krueger

**668 Biology of Reproduction in Animals (II, 3)** Evolution of sexual reproduction, neuroendocrine signals, and behavioral controlling mechanisms in diverse phyla. (*Lec. 3*) *Pre: 545, 561, or 567.* Twombly, Specker, and Cobb

**675 Advanced Ecology Seminars (I and II, 2 each)** Specialized and advanced areas of ecological research and theory, including zoogeography, Pleistocene ecology, population dynamics, energy flow in ecosystems, and radiation ecology. *Pre: permission of instructor.* Staff

**679 Animal Communication**  
See Oceanography 679.

**691, 692 Directed Research (I and II, 1-3 each)** Subject matter adapted to meet needs of the student. May be arranged with any staff member. (*Lec. 3 or Lab. 6*) *Pre: permission of chairperson.* Staff

**693, 694 Zoological Problems (I and II, 1-3 each)** Special work to meet needs of individual students who are prepared to undertake special problems. (*Lec. 1-3 or Lab. 2-6*) *Pre: permission of chairperson. S/U credit for 694.* Staff

**695 Graduate Seminar in Zoology (I and II, 1)** Students to give seminar reports on their thesis research. Attendance and registration required of all graduate students in residence, but only 2 credits may be applied to the program of study. *Pre: graduate standing. S/U credit.* Staff

**699 Doctoral Dissertation Research (I and II)** Number of credits is determined each semester in consultation with the major professor or program committee. *S/U credit.*

**930 Workshop in Zoology Topics for Teachers (I, II, or SS, 0-3)** Especially designed for secondary school science teachers. Basic topics in zoology from an advanced or pedagogical perspective. (*Lec. or Lab.*) *Pre: teacher certification.* Staff

## Other Courses

The following are courses grouped by additional subject areas, or courses that may be taken for graduate credit but are not part of a graduate program. Descriptions of the 400-level courses are found in the *Undergraduate Bulletin*. Where descriptions for 500-level courses are not provided, they can be found earlier in this bulletin.

### AAF Courses

#### African and Afro-American Studies

**410 (or PSC 410) Issues in African Development (I and II, 3)**

**474 (or ENG 474) Topics in Pan-African Literature (II, 3)**

### APG Courses

#### Anthropology

**400 Evolution, Culture, and Human Disease (II, 3)**

**401 History of Anthropological Theory (I or II, 3)**

**405 (or PSY 405) Psychological Anthropology (I or II, 3)**

**412 Primate Behavior and Organization (I or II, 3)**

**413 (or MAF 413) Peoples of the Sea (I, 3)**

**470 Problems in Anthropology (I and II, 3)**

### ART Courses

#### Art

**405, 406 Studio Seminar (I and II, 3 each)**

**501, 502 Graduate Studio Seminar I, II (I and II, 3 each)** Intensive independent studio work under guidance of instructors. Periodic critiques and discussions related to work of all participants in the course. (*Studio 6*) *Pre: 48 credits in studio for 501; 501 for 502.* Staff

### ARH Courses

#### Art History

**461 Topics in Methods, Theory, and Criticism (I or II, 3)**

**462 Contemporary Art Seminar: Art Since 1945 (II, 3)**

**469, 470 Art History: Senior Projects (I and II, 3-6 each)**

**480 Advanced Topics in European and American Art (I or II, 3)**

### COM Courses

#### Communication Studies

**400 Rhetoric (I, 3)**

**403 Advanced Interpersonal Communication (I, 3)**

**415 The Ethics of Persuasion (I, 3)**

**420 Seminar in American Public Address and Criticism (II, 3)**

**430 Political Communication (I, 3)**

**435 Directing Group Performance of Nondramatic Literature (II, 3)**

**440 Telecommunications Processes and Audience Behavior (I and II, 3)**

**450 Organizational Communication (I and II, 3)**

**460 Communication and Conflict Intervention (II, 3)**

**471, 472 Internship in Speech Communication (I and II, 3 each)**

**491, 492 Special Problems (I and II, 1-3 each)**

### CNS Courses

#### Consumer Studies

**401 Consumer and Managerial Problems of Families with Special Needs (I or II, 3)**

**420 Consumer Protection (I or II, 3)**

**422 Consumer Issues Research (I or II, 3)**

**457 (or HLT 457) Health and Safety Issues of Consumer Products (I or II, 3)**

**470 Special Problems (I and II, 2-4)**

**570 Special Problems (I or II, 3)** Advanced study to be selected from areas of home management theory and its application, work simplification, family economics, and equipment. (*Lab. TBA*) Staff

### DHY Courses

#### Dental Hygiene

**462 Oral Care of the Aged and Medically Compromised (I, 3)**

**464 Field Experience in Community Oral Health (II, 3)**

### Genetics Courses

#### Botany

**454 Genetics Laboratory**

**554 Cytogenetics**

**579 Advanced Genetics Seminar**

#### Microbiology

**410 Molecular Genetics of the Protozoa**

**502 Techniques in Microbial and Molecular Genetics**

**552 Microbial Genetics**

**561 Recent Advances in Molecular Cloning**

#### Plant Sciences

**472 Plant Improvement**

#### Zoology

**518 Mechanisms of Development**

**573 Developmental Genetics**

**579 Advanced Genetics Seminar**

### Gerontology Courses

#### Human Development and Family Studies

**420 Human Development During Adulthood**

**421 Death, Dying, and Bereavement**

**422 Aging: Case Coordination**

**431 Family and the Elderly**

**440 Environmental Context of Aging**

**520 Developmental Issues in Later Life**

**527 Health Care Policy and the Elderly**

**529 Practicum Seminar in Gerontology**

**555 Gerontological Counseling**

**Human Science and Services**

530 Multidisciplinary Health Seminars for the Elderly

**Dental Hygiene**

462 Oral Care for the Aged and Medically Compromised

**Adult and Extension Education**

575 Adult and Cooperative Extension Programming for Older Adults

**Education**

410 Seminar and Supervised Field Practicum in Education of the Aging

**Nursing**

563 Advanced Clinical Study of Nursing Practice in Gerontology

**Physical Education**

563 Physical Fitness Programs for the Middle-Aged and Elderly  
564 Physiology of Aging

**Recreation**

416 Aging and Leisure

**Sociology**

438 Aging in Society

**HED Courses****Home Economics Education****506 Instructional Communications**

(I or II, 3) Selection, organization, and use of instructional materials, methods, and techniques for effective home economics teaching in a formal or informal educational setting. (Lec. 3) In alternate years. Staff

**507 Curriculum Development (I or II, 3)**

New developments in curriculum planning as related to organization and administration of comprehensive and occupational home economics and other vocational programs; evaluation as it relates to an effective program. (Lec. 3) Pre: one year of teaching experience or permission of chairperson. In alternate years. Staff

**509 Seminar in Home Economics Education (I or II, 3)**

Study of current trends and issues as they affect home economics education; critical study of research literature and techniques appropriate to solution of problems. (Lec. 3) In alternate years. Staff

**586, 587 Problems in Home Economics Education (I and II, 3 each)**

Advanced work for graduate students in home economics education. Conducted as seminars or as supervised individual projects. (Lec. or Lab.) Pre: permission of chairperson. Staff

**595 Master's Project: Action Research**

(I and II, 1-6) Candidates plan and carry out an action research project approved by the instructor. Number of credits is determined each semester in consultation with the major professor. Pre: admission to a master's program in home economics education, a course in research methods, and permission of chairperson. May be repeated for a maximum of 6 credits. Staff

**JOR Courses****Journalism**

410 Mass Media Issues (I or II, 3)

415 Perspectives on Reporting (I or II, 3)

420 Advanced Reporting and Writing (I or II, 3)

430 Advanced Television News (I or II, 3)

440 Independent Study (I and II, 1-3)

441 Public Relations Practices (II, 3)

445 Special Topics in Journalism (I and II, 3)

**LAR Courses****Landscape Architecture**

444 Landscape Architecture Studio III

(I, 4)

491, 492 Special Projects and Independent Study (I and II, 1-3 each)

**Latin American Studies Courses****Anthropology**

470 Problems in Anthropology

**History**

580 Colloquium in Latin American History

**Political Science**

431 International Relations

**Portuguese**

497, 498 Directed Study

**Spanish**

487 Modern Spanish-American Narrative

497, 498 Directed Study

571 Modern Spanish-American Authors

572 Evolution of Spanish-American Culture and Thought

590 The Hispanic Presence in the United States

**NES Courses****New England Studies**

400 Special Topics in New England Studies (SS, 1-3 each)

**SOC Courses****Sociology**

401 History of Sociological Thought (I or II, 3)

408 Individual Life and Social Order (I or II, 3)

413 Sexual Inequality (I or II, 3)

414 Demography (I or II, 3)

420 Family Violence (I or II, 3)

424 Health Care Delivery Systems (I or II, 3)

428 Institutional Racism (I, 3)

432 (or LRS 432) Industrial Sociology (I or II, 3)

437 (or HCF 437) Law and Families in the United States (I, 3)

438 Aging in Society (II, 3)

452 Class and Power (II, 3)

470, 471 Independent Study (I and II, 3 each)

505 Public Program Evaluation

See Political Science 505.

**521 (or PSC 531) Behavior Systems in Crime (I, 3)**

Criminal behavior studied in categories useful for sociological analysis. Linkages of criminal behavior systems to the larger society; behavior systems in causal theorizing, justice, prevention, and corrections. (Lec. 3) Pre: 330 or equivalent. In alternate years. Carroll

**522 (or PSC 522) Issues in Corrections (II, 3)**

Justifications for punishment and corrections; historical development; intensive survey of current research on deterrence, effectiveness of treatment, prison, violence, and other issues. (Lec. 3) Pre: 330, EST 408, SOC 507, or permission of instructor. In alternate years. Carroll

**523 Institutional Racism (I, 3)** Consideration of varying models of race and ethnic relations; examination of recent research on issues such as residential segregation, school desegregation, affirmative action, and racial disorders; comparisons of the United States with other societies. (Lec. 3) Pre: EST 308, SOC 507, or permission of instructor. In alternate years. Carroll and Reilly

**571, 572 Directed Study or Research (I and II, 3 each)**

Designed to cover areas of special research interests of graduate students not covered in other courses. (Lec. 3) Pre: permission of chairperson. Staff

**595 Problems of Modernization in Developing Nations**

See Resource Economics 595.

**Statistics Courses****Economics**

576 Econometrics

**Electrical Engineering**

584 Pattern Recognition

**Experimental Statistics**

409 Statistical Methods in Research I

412 Statistical Methods in Research II

413 Data Analysis

415 Introduction to Experimental Design

416 Survey of Advanced Statistical Methods

491 Directed Study in Experimental Statistics

492 Special Topics in Experimental Statistics

500 Nonparametric Statistical Methods

501 Analysis of Variance and Variance Components

502 Applied Regression Analysis

517 Small N Designs

520 Fundamentals of Sampling and Applications

532 Experimental Design

541 Multivariate Statistical Methods

542 Discrete Multivariate Methods

550 Ecological Statistics

576 Econometrics

584 Pattern Recognition

591 Directed Study in Experimental Statistics

592 Special Topics in Experimental Statistics

610 Parsimony Methods

611 Linear Statistical Models

612 Structural Modeling

635 Response Surfaces and Evolutionary Operations

**Industrial and****Manufacturing Engineering**

411 Probability for Engineers

412 Statistics for Engineers

513 Statistical Quality Control

533 Advanced Statistical Methods for  
Research and Industry634 Design and Analysis of Industrial  
Experiments635 Response Surfaces and Evolutionary  
Operations**Management Science**

445 Managerial Applications of Simulation

450 Forecasting: Computer Applications

470 Managerial Decision Support Systems

475 Bayesian Statistics in Business

601, 602 Advanced Management Statistics

630 Management Statistics with SAS and  
Personal Computer Software

671 Methods of Business Research

674 Business Research Methods: Applied  
Multivariate Methods675 Applied Time Series Methods and  
Business Forecasting676 Applied Econometric Methods in  
Business

683 Business Decision Theory

**Mathematics**451 Introduction to Probability and  
Statistics

452 Mathematical Statistics

456 Probability

550 Advanced Probability

551 Mathematical Statistics

**Mechanical Engineering****and Applied Mechanics**

521 Reliability Analysis and Prediction

**Psychology**

517 Small N Designs

533 Advanced Quantitative Methods in  
Psychology

610 Parsimony Methods

612 Structural Modeling

**Quantitative Business Analysis**

530 Statistical Methods for Management

**THE Courses****Theatre**481 Topics in Theatre (*I and II, 3*)482 Theatre Architecture in Western and  
Non-Western Drama (*I, 3*)483 Aesthetics and Criticism of the  
Theatre (*II, 3*)**URB Courses****Urban Affairs**498, 499 Urban Affairs Senior Seminar  
(*I and II, 3 each*)**WMS Courses****Women's Studies**400 Critical Issues and Feminist  
Scholarship (*I or II, 3*)450 Independent Study (*I and II, 3*)

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